



Bio-CLIMA Nicaragua

“Integrated climate action for reduced deforestation and strengthened resilience and in the Bosawas and Rio San Juan Biosphere Reserves”

Annex 2c

Feasibility Study for Landscape Restoration through Sustainable Cocoa Agroforests within the Bio-CLIMA Project

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Acronyms and abbreviations

APEN	Nicaraguan Association of Producers and Exporters
BAU	Business As Usual
CACAONICA	Cooperativa de Servicios Agroforestal y de Comercialización de Cacao R.L.
CANICACAO	Nicaraguan Chamber of Cocoa Producers
CATIE	Tropical Agronomic Center for Research and Teaching
CRS	Catholic Relief Service
FIDA	International Fund for Agricultural Development
GAP	Good Agricultural Practices
GHG	Greenhouse Gas
ICCO	International Cocoa Organization
INETER	Nicaraguan Institute of Territorial Studies
INTA	National Institute of Agricultural Technology
IPADE	Institute for Development and Democracy
IPSA	Institute of Protection and Animal Health
LWR	Lutheran World Relief
MAB	Man and the Biosphere program from UNESCO
MAG	Agricultural Ministry
MAGFOR	Ministry of Agriculture and Forestry (now extinct)
MARENA	Ministry of Environment and Natural Resources
MEFCCA	Ministry of Family and Community Economy
MIFIC	Ministry of Industry and Commerce Development
MOCCA	Maximizing Opportunities in Coffee and Cocoa in the Americas
MT	Metric Tons
NGO	Non-Governmental Organization
NICADAPTA	Climate Change Adaptation Support Program through the Production of Coffee and Cocoa from Small Producers in Suitable Agroclimatic Zones
PCC	Cocoa Project of Central America
PMG	CATIE's Genetic Improvement Program
PROCACAO	Improvement of the organizational and productive capacities of cocoa producers in the Mining Triangle
RACCN	North Caribbean Coast Autonomous Region
SDC	Swiss Agency for Development of Cooperation
UNIDO	United Nation Industrial Division Organization
USDA	United States Department of Agriculture

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I. Executive summary

Located in the North-central region of Nicaragua, BOSAWAS Biosphere Reserve is one of the largest terrestrial protected areas in Central America. It is the reservoir of an incredible biodiversity of flora and fauna, which constitutes part of the Mesoamerican Biological Corridor. However, the area is suffering drastic deforestation, principally motivated by the extension of the agricultural frontier and over-exploitation of wood.

The consequences of deforestation and the degradation of forest areas are severe: impoverishment of the soil, carbon release, contamination of natural resources such as water, air, soil and loss of biodiversity to name a few.

To halt and, if possible, counterbalance the effects of deforestation, it is necessary to rehabilitate the landscape through sustainable models of reforestation. In this project, we describe a model of Landscape Restoration through Sustainable Cocoa Agroforests, and analyze its feasibility.

The proposal focuses mainly on providing the possibility of reversing the destruction of natural resources in the municipalities of Wiwili, Cua Bocay, Waslala, Siuna, Bonanza and Waspán of the North Caribbean Coast Autonomous Region (RACCN). The area of implementation is suitable for the cultivation of cocoa, through an adaptation of the conventional production system and appropriate management practices to achieve sustainable production and higher yields. Renovation and rehabilitation of abandoned grassland areas with slopes less than 50% are considered, representing a potential cocoa cultivation area of more than 13,700 ha.

The management model proposed is suited to the edaphoclimatic characteristics of the territory (actual and future) and of the small producer's reality. This initiative optimizes the use of the space available to small producers, estimated at 2 ha per farm, combining reforestation with the production of high productivity cocoa clones, adapted to future climate change scenarios, with local fruit and forest trees species, in grassland areas where sustainable management must be considered as a priority.

This model of Cocoa in Agroforestry System is based on local learning and vulnerabilities. It integrates the lessons learned from previous experiences developed by public and private actors.

a) Characteristics of the territory for the model implementation

This proposal for cocoa production seeks that the indigenous and mestizo families of the RACCN region improve their livelihoods, increase their resilience to environmental changes and natural disasters and achieve greater food security. This model of implementation will take place in the region of BOSAWAS, particularly in indigenous, mestizo, or third-party lands occupied with pastures, where current and future climate scenarios show land compatibility for cocoa cultivation.

It is expected to achieve the reforestation of 4430 ha with cocoa in agroforestry. It will be implemented over a seven-year period, which would increase the capacity to accompany the establishment of the model and with it, the implementation of the best-practices defined for this activity. When possible, the implementation will be based on a cluster approach to foster cooperation and learning between actors, to capitalize and to integrate anchor companies and producer organizations with their learning and potential; particularly those related to cocoa clone reproduction and technical assistance, which progressively creates the connection to markets.

b) The beneficiaries

The project is expected to reach directly 2215 producer families (2 ha per family).

Indigenous territorial authorities will have a very important role in the identification of potential beneficiaries since it is imperative to achieve areas as compact as possible and thereby leverage the generation of impact in terms of density and visibility.

Indigenous peoples own the largest amount of land and therefore it is crucial to capitalize on the relationship they have with the land and its resources. The identification and selection of participants will be overseen by community leaders and must comply with the indicated requirements: farms smaller than 10 hectares, out of which 2 ha of land would be suitable for cocoa cultivation, interest in participating in socialization and training workshops, willing to sign agreements with the commitments of the project. Women land tenants will be prioritized to enter the project. Particularly young people, especially women, will be subject to training for the establishment of the crop and the reproduction of forest and fruit plants using modern techniques for plant reproduction.

c) Cocoa clones of high quality and productivity

For the selection of the cocoa clones that are best suited to the intervention zone defined, the following criteria will be used: i) the experience of the established cocoa clonal arrangements, ii) the productivity generated under agroforestry systems, iii) a quality consistent with market demands.

The cocoa plantation will be established in a triclinal arrangement, where the combination of the clones CATIE-R6, PMCT-58 and ICS-95 avoids problem of genetic incompatibility. The use of these clones, which have been developed after more than 20 years of research and selection by CATIE, is mainly aimed to improve the income and living conditions of producing families. Moreover, this mixture of clones produces a good amount of drool for the fermentation and the development of flavor precursors, enhancing the sensorial quality of the cocoa beans.

d) Forestry system: the use of fruit and native timber trees species

For the reforestation, the model includes the incorporation of native species that can be taken from the natural regeneration of smallholder plots. Not only will they provide shade for the cocoa plants, but they will also add value to the farm, capture carbon emissions, and ensure food security.

Native species with low management requirements, with high regrowth and carbon capture capacity that are naturally resistant to pests and diseases will be privileged. The recommended trees have deep roots that do not compete with the roots of the cocoa plants, allowing them to capture nutrients from deeper soil layers.

Fruit species will be selected based on producer family needs and market potential. Forest tree production will be assigned to community initiatives or to the farmer himself via on-farm plant propagation, while cocoa clones must be managed in a specialized manner to ensure traceability and quality through the certification of genetic purity.

Agroecological management practices should benefit from the natural resources present in the area, such as the use of short cycle crops, organic nitrogen source, composting fertilizers and cattle manure. Pruning

of branches and tree mulch will be used as a contribution of organic matter that helps with the improvement of the soil.

e) Promoting leverage for market access

Worldwide, cocoa demand is increasing, which impact positively the local market. Cocoa produced in an agroforestry system with agro-ecological practices aims to reach adequate markets, with prices according to the quality of the beans and with policies that favor the development of the sector.

Competitiveness of the cocoa produced through the project will be strengthened through technical assistance, field tour and training. The project will focus on strengthening the cooperatives; improving volume, quality, and consistency; ensuring transparency and traceability; and facilitating access to credit and certification.

High quality, uniformity, reproducibility, and flavor are keys to achieve added value. The standardization of fermentation and drying protocols is a challenge that would be able to sustain the quality of the cocoa and to preserve its natural flavor.

The promotion of the efforts made to reach sustainability in an integrative manner could be achieved through a paired certification strategy, which valorizes both the production of sustainable cocoa and the efforts made at the landscape level (reforestation, carbon capture, biodiversity). To achieve a better impact, certification through cooperatives or buyers is recommended, and should be part of the technical assistance provided by the project during the first two years.

Public and private partners will join their efforts to follow the pre-established strategies of the Cocoa Culture National Plan of Nicaragua, to promote sustainable development in the value chain, seeking the consolidation of established markets and opening new ones, without losing the road map of fine Nicaraguan cocoa.

f) Creation of a trust

The execution of this proposal supports its strategy in the use of a trust as a figure for the credit management. The credit would be managed by the Technical Unit, within the framework of the local laws and regulations. The trust will operate with two sources of funds (from the project and from the private sector) that will be established as debt, and may be donated totally or partially depending on the level of commitment and compliance with indicators that guarantee the application of the practices defined. Small producers will reimburse their debt in the form of payment with carbon credits obtained through the reforestation of their land, as well as a fraction of their cocoa production.

Co-financing of the project by the private sector can be considered in the form of advance payments to producer organizations, allowing them to buy cocoa in drool, process it and market it. Additionally, private companies can co-execute some components such as technical assistance and financing for the management and the purchase of the crop.

g) Socio-economic and environmental impacts and sustainability

Sequestration and storage of GHG

Agroforestry cocoa systems store significant amounts of carbon and, therefore, have the potential to mitigate climate change. The composition of the agroforestry system provides a broad set of morphological and functional features, which allows to experiment with different species to optimize the

design of the model. Considering a pasture landscape baseline of 2.4 tCO₂eq/ha/year, the cocoa agroforestry system will increase the storing capacities of the land to 5.4 tCO₂eq/ha/year, corresponding to a carbon capture rise of 44% (Somarriba *et al*, 2013).

Reduction of the environmental impacts of deforestation

The cocoa model in the agroforestry system aims to reforest with a density of 1734 trees per ha, including 816 cocoa trees, 816 musaceae plants, 51 forest trees, and 51 fruit trees. This model will mitigate the effects of deforestation, mainly emissions from land use, deforestation, and forest degradation. Planting trees will allow the communities to:

- Mitigate global warming, soil loss,
- Restore hydrological cycles,
- Rehabilitate habitats for fauna and flora, as well as scenic and landscape beauty,
- Increase biodiversity,
- Increase the production of timber and non-timber forest products,
- Increase agricultural production by increasing the fertility of the soil,
- Reduce soil erosion
- Recreate and reactivate biological and ecological corridors of the BOSAWAS buffer zone.

Increase of income for producers

The model expects an average cocoa production of 935 kg/ha/year, with access to the market. This translates into an annual gross income of about USD 4,290 per family, for 2 ha of cocoa production, which is equivalent to double the minimum wage of the country. Moreover, the planting of timber trees will add value to their farm.

The model proposes to finance 2 ha of cocoa per family, in order to favor a production volume that ensures that future income will not be as sensitive to price fluctuations, when compared to smaller size productions. The model prioritizes the controlled expansion of beneficiaries depending on the results of the first year, promoting investment in producers that show an effective interest in fulfilling the commitments. In this initiative, the Private Sector can facilitate access to markets with more stable prices that enable small producers to have a projected income. In return, this situation encourages the planting of new areas of cocoa that would be the key to increasing their productive scale and their income standard.

Moreover, for the different communities of the region, the establishment of annual crop, banana, and fruit trees largely marketed, will have a positive impact on their income and will provide labor opportunities.

Women's entrepreneurship

The program would have the possibility to develop affirmative measures to integrate women who wish to become entrepreneurs. One of the options is that the assisted reproduction of forest species is left in their hands, using reproduction techniques by buds, using less polluting materials, such as tubes and ellepot trays in controlled environments.

Food security

The production generated by the fruit trees included in the agroforestry system will contribute to increase the availability of food, and favor an improvement of the family's diet.

In a nutshell, cocoa in agroforestry systems will contribute to the recovery of degraded areas in the region of BOSAWAS. It will allow sustainability, resilience, and restoration of biodiversity and ecosystem services, while ensuring food and income in one of the most vulnerable areas that is subject to deforestation and with some of the highest levels of poverty in Nicaragua.

II. Description of the baseline and conventional systems for the production of cocoa in the BOSAWAS biosphere reserve

The present characterization aims to establish the basis for determining the appropriate production method and to meet the objectives of Bio-CLIMA, in the northern area of Nicaragua, specifically in the buffer zone of BOSAWAS, a biosphere reserve recognized since 1997 by the Man and the Biosphere (MAB) program of UNESCO. The proposal focuses mainly on the municipalities of Wiwili, Cua Bocay, Waslala, Siuna, Bonanza and Waspán, which provide the possibility of reversing the destructive causes of resources exploitation (mainly deforestation and over-exploitation of soils with grasslands) and environment, and favor the consolidation of the Mesoamerican Biological Corridor.

A. The context of cocoa in the BOSAWAS region

1. Historical background of cocoa in the territory of BOSAWAS

The main references of cocoa production in the Autonomous Region of the North Caribbean Coast (RACCN) are mainly located in the municipality of Waslala, whose first experiences date from 1961 (Trognitz, et al., 2011).

In the 70s, the inhabitants of the Waslala area produced cocoa in the wild, in the surroundings of the current municipal capital, mainly for self-consumption. However, attacks by monilia and other pests caused cocoa activity to move towards the depths of the territory.

In 1979, in Waslala, cocoa production was promoted by the government with the planting of 2,500 ha. The productive structure was characterized by smallholdings or subsistence systems. It is in the 1980s that cocoa increases its economic importance for small rural farmers (NICARAGUA COCOA SECTOR COMMISSION, APEN, SDC, 2018). By 1985, demonstration plots had been established in Zinica and El Naranjo using hybrid varieties from the El Recreo experimental station (FUNICA, 2007).

In the 90s and early 2000, cocoa activity fell into crisis causing massive plantation abandonment due to internal factors (pests, low quality genetic material, technological ignorance) and external factors (prices lower than the internal price, with very demanding quality standards). Therefore, the 90s were marked by a national decrease in production and proliferation of the Monilia disease (*Moliniophthora roreri*).

In the other hand, still in the 90s, the Ritter Sport Chocolate Company of Germany began supporting the CACAONICA cooperative through the NGO Pro Mundo Humano, supporting agroforestry systems, organic cocoa production and the association of small producers, with effect on other areas of the Caribbean Coast region (CEI, 2013).

In 2004, IICA, CACAONICA and the Pro Mundo Humano, collaborated with the primary objective of promoting organic cocoa trade and fair price through assistance to strengthen cooperatives, the promotion of sectorial policies and the development of agribusiness (IICA, 2004).

In 2006, the Humboldt Center, in collaboration with the European Union, Hivos, and the Government of Denmark (Danida), implemented a cocoa agroforestry project “Development of Sustainable Means and Ways of Life”, on the agricultural frontier of the reserve of BOSAWAS Biosphere, with 16 Mayangnas communities and 27 Miskito communities, located on the banks of the Coco and Bocay River (Anon., 2011) This project established agroforestry systems with cocoa, fruit and timber trees, such as cedar and mahogany, mainly in degraded areas. The planting of cocoa was done from seeds. The technological

package included the establishment of two collection centers (Las Piedras and Ayapal), technical assistance, training, exchange of experiences and market connections with RITTER SPORT.

The Program “Promotion of the production, transformation and commercialization of cocoa in Nicaragua” (2007-2014), implemented by MAGFOR within the framework of PRORURAL, developed actions for the establishment and management of cocoa plantations with innovative technology, technical assistance and training in: Waslala, Mining Triangle, Waspán and Prinzapolka (MAGFOR, 2019).

In 2011, the Fourth Agricultural Census (IV CENAGRO) evidenced that of the 20,541 farms that existed in the RACCN; 11,811 of them had 1 or more permanent and semi-permanent crops in a total of 15,596 ha. In this region, 3,913 ha were dedicated to cocoa, which represents 40% of the total registered in the country (9,845 ha) (FAO, 2011).

Since 2015 the Ministry of Family, Community, Cooperative and Associative Economy (MEFCCA) together with the Technical Support Unit of the United Nations Industrial Division Organization (UNIDO) and Swiss Cooperation funds (SDC) executed the program “Improvement of the organizational and productive capacities of cocoa producers in the Mining Triangle”, PROCACAO (2014-2017, US \$ 4.2 million) (UNIDO, 2017). This project was developed in two stages, the first supported 1,200 producers and their organizations located in the Mining Triangle, through organizational, business and technical capabilities strengthening, as well as technical assistance and credit access (Artola, 2017). A second stage (2018-2020) provides for the integration of 1,200 new producers, with this credit fund and the development of alliances with other actors in the cocoa sector. This program developed a plan to renew plantations with fine cocoa with criollo origin, robustness improvement through grafting, increasing the number of cocoa plantation to 700 cocoa plantations (Cerón M, 2017).

In 2017, IPADE, with support from the European Union and Diakonia, established 225 ha of cocoa under Agroforestry Systems (AFS) with timber, fruit trees and bananas, in 15 indigenous and mestizo communities in Siuna, serving 181 families (LA PRENSA, 2017).

The project PROGRESA CARIBE, funded by the United States Department of Agriculture (USDA) for an amount of 7.70 million dollars, (Nicaraguan Central Bank, NCB) was implemented by a consortium of organizations led by Catholic Relief Service (CRS) from 2015 to 2018, serving 4,250 producers in the Caribbean region. The project was aimed at increasing the value of the product, bringing producers closer to the market and increasing their productivity. The Climate Change Adaptation Support Program through the Production of Coffee and Cocoa from Small Producers in Suitable Agroclimatic Zones (NICADAPTA, 2014-2020, USD 37 million) seeks to improve the living conditions of rural families producing coffee and cocoa, reducing their vulnerability to climate change (GOBIERNO DE NICARAGUA, 2017). The funding sources are CABI, IFAD (Loan and Donation). The institutions involved are MEFCCA, INTA, IPSA, MAG, MIFIC, INETER and the Caribbean Coast Secretariat. The project benefits 40 thousand families that own less than 14 ha of land.

The Knowledge Management Project of the Cocoa Value Chain in Central America (RIKOLTO-SDC, 2018-2021, USD 1.5 million), aims to contribute to the transformation of the cocoa sector towards higher competitiveness and resiliency to climate change, through public policies and information generation that facilitates Central American producers to increase their income levels and (self) employment.

The Maximizing Opportunities in Coffee and Cocoa in the Americas (MOCCA) Project, financed by USDA (USD 36 million for 6 countries), will be implemented in Nicaragua by Lutheran World Relief LWR, with the goal of establishing and renovating 2,000 ha starting in 2020, but to this date, no details have been published about the area of implementation.

2. [Lessons learned from the previous projects](#)

Reinforce technical management

The management of a project demands specific operational and strategic strengths at different levels. The closer the project is to the field, the more operational capacity is developed. However, strategic management is essential to plan, monitor, evaluate and manage knowledge of where the project is going in terms of objectives and results. The imbalance in both priorities can lead to unwanted consequences that can negatively impact the results of the project.

NICADAPTA privileged the operational part, in order to meet its physical-financial goals and in the medium term, it had practically exhausted the planned resources, falling short in the fulfillment of goals and in the establishment of strategic elements that would ensure compliance with the objectives and their expected results.

NICADAPTA and PROCACAO formed technical teams with incipient capacities in the management of cocoa cultivation. This reality, coupled with a limited induction strategy, caused decisions such as the elimination of shade before the establishment of cocoa, which was detrimental to the crop. The substantive elements of project design, before being implemented, must be contrasted with conceptual referents and ensure that the theory is properly put into practice (FIDA, 13- 27 Nov-2017). The subordination of technical criteria to political criteria limits the ability to generate a greater impact at the territorial level. Moreover, some producers present in the territory were not incorporated due to the prevalence of other criteria such as political affiliation.

NICADAPTA contemplated the implementation of environmental and water management practices and technologies to reduce the vulnerability of rural families to climate change. Its design focused on environmental and water management aspects, however, many concepts, definitions and methodologies for measuring threat, risk and vulnerability, as well as constituent awareness, fell short in relation to the procedures for social, environmental and climate assessment. The lack of technical knowledge on climate change diminished the possibility of sufficiently addressing the issue during the period implemented.

Enhance Public-Private actors' coordination

The role of the State is strategic to favor synergies and complementarities between local actors that would facilitate the scaling-up of the impact. However, there is insufficient public and private articulation in each cocoa-growing territory, restricting learning opportunities and alliances to enhance the development and growth of the sector. The dialogue platforms that once existed in each municipality of the mining triangle are inactive and without a visible conductor that energizes them.

In the RACCN, there is evidence of a separation between large private investments and cooperatives. The mining triangle presents a special situation in the country. In the same territory, we find three large companies investing in the establishment of thousands of hectares of cocoa with high technology and using the best genetic material available. In addition, they have specialized technical teams in the field. On the other hand, organized cooperatives and small producers are accompanied by public institutions

such as MEFCCA, INTA and IPSA and private organizations such as CRS and IPADE, which are directly linked to the small producers of cocoa. Nevertheless, communication is limited and there are still no common elements for discussion, coordination and implementation of initiatives with a territorial approach.

In the mining triangle, they are successful organizations of producers characterized by the good management of their processes: organizational, productive, processing, value aggregation, marketing, environmental and climate change management, social and equity, and innovation. They are stable organizations, with leaderships committed to the development of the human resources and the growth of their communities. Technical assistance and training processes are at the center of their actions (Nicaraguan Cocoa Sector Commission, APEN, SDC, 2018).

The NICADAPTA project works with those grassroots organizations that have a multiplicity of experiences, accumulated over the years, and that are capable of achieving results. They are able to sharing good practices and becoming prototypes of crop production and human development. An example, among several, is the case of the Augusto C. Sandino Multiple Services Cooperative (COOMULACS), which stands out for its stability, openness to change, successful approaches and sustainability (FIDA, 13- 27 Nov-2017).

In the intervention area of NICADAPTA, FIDA decided to establish alliances with specialized entities with experience in short-term adaptation to climate change (plantation management and design, disease control and resistance, water and soil management), as well as long-term adaptation (selection of species and varieties, diversification). This allowed to increase the productivity and maintain the quality of the products. Access to climate information allowed producers to make better decisions and improve their resilience (FIDA, 13- 27 Nov-2017).

Strengthen producers' organizations

In the NICADAPTA project report, FIDA emphasizes that the promotion of rural businesses requires investments in line with the management capacity of each organization. The appropriation of the business by the organization, its strategy of inclusion of women and youth, as well as its ability to assume financial risks potentiate successful business opportunities. The inclusion of small producers in the markets and the stable and sustainable participation of their organizations continues to be a challenge, so investments in this segment must be reinforced by their validity and relevance.

The loyalty of the partner and the provider to their cooperative is minimal and is subject to the fluctuations of the market. A slight movement in the purchase price generates a change in the behavior of the partner, who sells its production or part of it to any intermediary that occasionally or regularly reaches the communities that produce cocoa.

Working on the organizational and business aspects constitutes a challenge for rural cooperative organizations and is the responsibility of the different public and private organizations dedicated to working with the producers, emphasizing these aspects and strengthening leadership at all levels. Intense work must be done in the sentiment of belonging of the producers to their cooperative (Nicaraguan Cocoa Sector Commission, APEN, SDC, 2018). This situation, added to the low supply of services that cooperatives give to their partners and suppliers, is what generates a dual behavior of the producer.

Reinitiate a regional dialogue platform

The articulation of the private actors with the public institutions in the promotion of cocoa has been insufficient, if not nonexistent, in recent years. This is a structural weakness of the mining triangle not having effective public private dialogue platforms, which allow articulating the efforts of the various actors along the value chain of an emerging crop that has a promising future in these municipalities.

Working in this direction in governance mechanisms and in the generation and creation of effective platforms that allow coordinating actions, strategy, resources and goals should be a priority for the coming years. Failure to do so would directly undermine the sustainability of the various efforts being promoted and would also generate duplication of forces, inefficient expenditure of economic resources and waste of trained human personnel located in the different agencies and institutions that work in the cocoa sector.

A priority for the present and near future in these territories is the definition of medium and long-term plans and goals taking into account the presence of large private investments in the three municipalities of the mining triangle (Siuna, Bonanza, Rosita). For all the actors it is a first order task to define the direction of the cocoa sector with the presence of large areas of cocoa of high productivity and the cooperatives (Nicaraguan Cocoa Sector Commission, APEN, SDC, 2018).

An regional effort of complementarity should be promoted to take advantage of the technical experience of the large company and also articulate the commercialization of cocoa, since these companies themselves become potential buyers of the production of the cooperatives.

A relevant actor that has been present in the mining triangle for years is the Ritter Sport chocolate company. It has developed important capacity development processes for cooperatives in regards to post-harvest, and now also accompanies the development of demonstrative plots where technified productive processes are implemented with the purpose of showing that high yields can be achieved if adequate cultural work is carried out in each cocoa plot in the hands of a small producer.

This company is currently the benchmark for the various cooperatives in the marketing of fermented and dried cocoa and has also promoted the certification of about 500 cocoa plots in the last three years. The certification process is also a first order task that should continue in each of the municipalities until reaching the largest number of organized and individual certified producers.

Provide access to financial services

The providers of financial services in the Mining Triangle for the cocoa sector are concentrated in the CARUNA Microfinance Company. During the years 2015-2017, it has managed the credit fund established by PROCACAO aimed at more than 700 families organized in cooperatives and solidarity groups. The financial FDL goes in the same direction, with more specific products. FDL works with higher interest rates (33% per year). Likewise, financial system institutions such as LAFISE and BAC located in Siuna, Rosita and Bonanza, have financing products for production in general, including cocoa with interest rates of 16% per year.

Due to the conditions of legality of the properties of producers organized in cooperatives and of individual producers, credit access is still limited since they do not have sufficient legal guarantees.

3. Proposal for national Cocoa policy

In the period of 2009 and 2010, a draft document of National Cocoa Policy with an agroecological approach was approved. It resulted from the advocacy actions of the National Cocoa Board and MAGFOR. This proposal was subject to extensive consultation with actors in the sector: cocoa producers, productive organizations, government institutions, support agencies and international cooperation agencies (ECOM-GIZ, 2011).

This policy proposed the sustainable management of the cocoa production system, under an agroecological approach. This approach promotes the development of livelihoods, the human development of the actors involved, the technological improvement, the integration of productive processes, and a fair economic and agribusiness scheme.

Although different organizations and projects have promoted for more than a decade the definition of a National Cocoa Policy, to date the only concrete result that exists is the "Plan of Action of the national strategy for the development of Nicaraguan cocoa farming for 2018 to 2022". This document includes the feedback of the different actors of the Chain and was carried out within the framework of the Public-Private Partnership, led by the Cocoa Commission, CANICACAO, APEN and the technical teams of the governmental institutions of INTA, MEFCCA, MIFIC, IPSA and MAG.

The prioritized lines of action of the "National Strategy for the Development of Nicaraguan Cocoa Farming", are based on policies to transform the cocoa sector, one of its main purpose is the promotion of the adoption of innovative production technologies, sanitary initiatives, promotion and commercialization of cocoa and its derivatives, preserving the production of fine or aroma cocoa, and the production of high yield and quality cocoa.

At the beginning of 2018, workshops were held in the different territories, as well as at the national level, for the analysis of the problems and priorities of each actor and each region, so that it was possible to verify and include in the plan some actions to enhance the development of the different actors of the value chain.

However, the two efforts made to build consensus in the country have failed to establish long-term policies. The different actors were not able to agree on the construction of an institution to promote the development and the sustainability of the cocoa value chain in the country.

4. National cocoa Board

In recent decades, alliances between companies, NGOs, producers and public bodies have been promoted to build value chains that improve the production and marketing of local products and facilitate the fair inclusion of small producers in trade chains. In addition, the alliances have aimed to generate a political environment to produce new public goods (technologies, methodologies, financial and institutional arrangements) (Simas, 2012).

Until 2011, the organizations of the cocoa chain were involved in the processes of political articulation both at the level of territories and at the national level, emphasizing the dialogue on the policies that affect cocoa production. Nevertheless this dynamic, lowered its profile because small producers and cooperatives lost courage to participate in public policy building processes and limited themselves to the production and marketing of cocoa within the chain.

In October 2014, the Nicaraguan Chamber of Cocoa Producers (CANICACAO) was constituted as a trade organization formed by 16 organizations of cocoa producers distributed in thirteen cooperatives, two associations and a central cooperative, which bring together more than 2,000 producers, located in nine municipalities of the country.

CANICACAO focuses on collecting data on real cocoa production in the country, improving its competitiveness, and seeking commercial opportunities abroad. It aims to professionalize the production of cocoa in the country, mainly to improve the genetics of the plantations, to implement new irrigation systems and technologies that improve the productivity of the crop and consequently its commercialization abroad. Nonetheless, CANICACAO has not been able to legalize its status for 3 years and currently has no official legal status. Its current activity is minimal.

5. Experiences and initiatives developed in the RACCN

The main experiences developed in the RACCN have been constant since 2014, with pioneering interventions developed in 2004-2006. These experiences have been concentrated mainly in Waslala and the Mining Triangle, territories that have received strong support through different programs, three of them far-reaching (CARIBBEAN PROGRESS, PROCACAO, NICADAPTA). However, the territories of Puerto Cabezas and Waspán show incipient levels of organization and an embryonic experience in cultivation.

These experiences show that the extension of the territory and the distribution of small plots in distant communities, in addition to limiting the perception of the real impact of the projects, faces challenges related to the monitoring of the production and the development of common actions that allow the organization, the appropriation of innovations, and the commercialization with a business approach. This objective reality has caused practices of concentration in nearby access areas and duplication of actions.

Currently, some capacities are developed in technological, organizational, procedural (administrative controls) and production facilities (6,200 ha of cocoa established with half of them in production, nurseries and clonal gardens), and processing (collection centers and eight processing and drying centers) (NICARAGUA COCOA SECTOR COMMISSION, APEN, SDC, 2018). Different mechanisms have been implemented to configure technical and financial services that adapt to the characteristics of small producers. These experiences require validation to design more successful interventions that could adjust the processes in a better way.

Current public and private projects require an objective analysis of the advantages of considering interventions that develop a territorial cluster or a nucleus, to generate efficiency in the process and facilitate the integral development of producers and their families. The specialization and development of transparent and mutually beneficial partnerships is crucial in this context.

There are experiences that have implied an improvement in yields, however, they can be regarded as “cases”, because the yields in general are still considered low. The organizations that collect the cocoa have ventured more into processes of transformation and influenced aspects of standardization of fermentation and drying, orienting their strategy towards the challenge of using firewood as fuel, mainly during the rainy season.

Each experience developed has chosen to use special techniques, and strategies of production, credit and marketing adapted to their contractual referents. This same behavior is perceived in local organizations

that implement actions tailored to their benefactors without sometimes considering their own needs or experiences.

B. The potential of the Bio-CLIMA implementation area for the development of the cocoa chain

The BOSAWAS Biosphere Reserve name originates from the contraction of the names of the Bocay (BO), Saslaya (SA) and Waspuk (WAS) rivers that converge in this region. It is one of the most extensive forest areas located north of the Amazon, which covers 15% of the Nicaraguan territory. Located in the Caribbean region, it represents approximately 25% of the Atlantic Biological Corridor of Nicaragua. It has an approximate extension of 2 million ha, which is divided into 2 very different areas. The first constitutes a core zone of 735,491 ha, composed of primary non-intervened forests. The second zone includes an extension of 1.3 million hectares as a buffer zone where this project proposal focuses. The territory is distributed in the municipalities of Waslala, Bonanza, Siuna, Waspán, Wiwilí and Cua-Bocay, the latter being the one that covers 30% of the territory of the reserve.

Bio-CLIMA will take place in two zones: one located at the South West of the core of the reserve (North of the municipalities of wilily de Jinotega and San Jose de Bocay), and the other one boarding the South-East part of the reserve, which corresponds to the northern part of the buffer zone (northern part of the municipalities of Siuna, Bonanza, and Waspán).

1. Analysis of the edafo-climatic conditions of the territory

a) Current weather

(1) Precipitation, temperature and relative humidity

The buffer zone is characterized by having a humid tropical monsoon-type climate, with an average temperature of 26 °C that does not vary significantly throughout the year, and an average annual rainfall of 2800 mm. The rainy season takes place during the months of May to January, while the dry season corresponds to the months of February, March and April (Walsh, 2000).

The CIAT analysis classifies the climate of the project implementation area as suitable for the cultivation of cocoa, but of "uncertain suitability", which means that given the mixture of climates, it cannot be classified specifically. Two types of climate that surround the area are: cold-humid, in the municipalities of Waslala and Mulukukú with an average annual temperature of 24.7 °C and an average annual rainfall of more than 2600 mm; and very humid temperate in the eastern part at the North Caribbean coast, with an average annual temperature of 25.4 °C and an average annual rainfall of 3000 mm (Bunn, et al., 2019). The temperatures of both zones do not vary significantly throughout the year. Regarding precipitation, values above 600 mm are recorded during the wettest trimester.

The map of agroclimatic areas for cocoa in Nicaragua (Figure 1) identifies four types of them for cocoa in the region of implementation of Bio-CLIMA: hot and dry, temperate and very dry, "with limitation", and "uncertain aptitude". They are mostly suitable for the cultivation of cocoa.

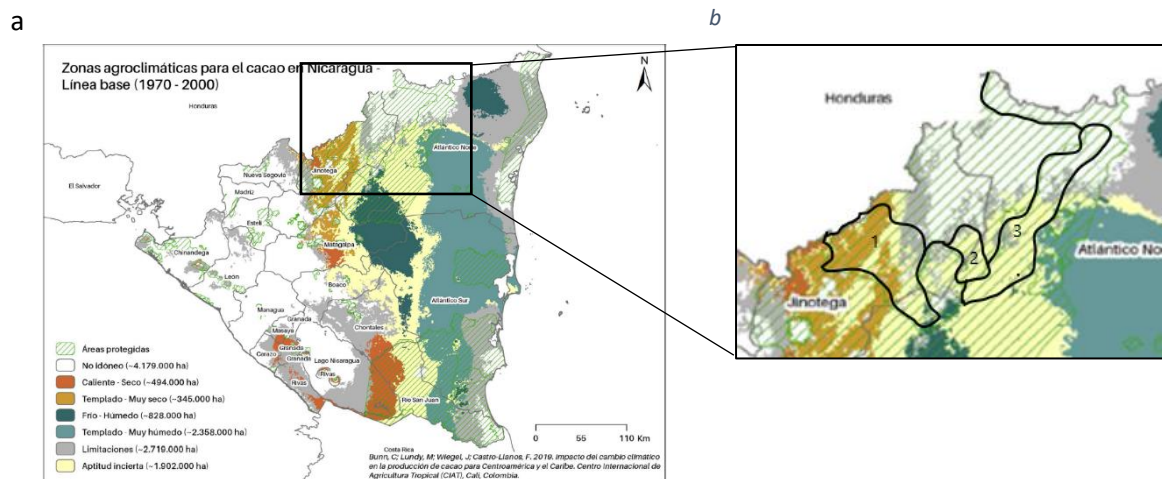


Figure 3. Agroclimatic areas for cocoa in Nicaragua (Bunn, et al., 2019) and zoom in on the region of implementation of Bio-CLIMA.

Within the area of implementation of the project, the characteristics of the agroclimates are the following:

- North part of the municipality of Jinotega and San Jose de Bocay, within the nucleus zone (area #1, Figure 1b): climate temperate and very dry, with half of the zone characterized as climate with "uncertain aptitude", due to its mixture of climate that is impossible to strictly characterize, but suitable for cultivation. It is necessary to stress on a small part located at the east part of this zone #1, where the study found that the climate is "with limitations" for cocoa production (zone with non-optimal climatic conditions for cocoa cultivation),
- South and East part within the nucleus zone (zone #2, Figure 1b): climate with "uncertain aptitude", due to its mixture of climate that is impossible to characterize, but suitable for cultivation,
- Western part of the Buffer zone (zone #3, Figure 1b): climate with "uncertain aptitude" in the municipalities of Siuna and Bonanza, and climate not suitable in the municipality of Waspán, principally due to rainfall and temperature not compatible with cocoa cultivation.

b) Climate change scenarios (CIAT)

The analysis of future climate scenarios published by CIAT (Figure 4) shows that the area of implementation of Bio-CLIMA will be at least suitable for cocoa cultivation until 2069 (limit of the study). Future scenarios did not allow this area to be classified in a specific type of climate, so it retains its "uncertain" characteristics for the future period of 2020-2069, which means unclassified but suitable for cocoa cultivation.

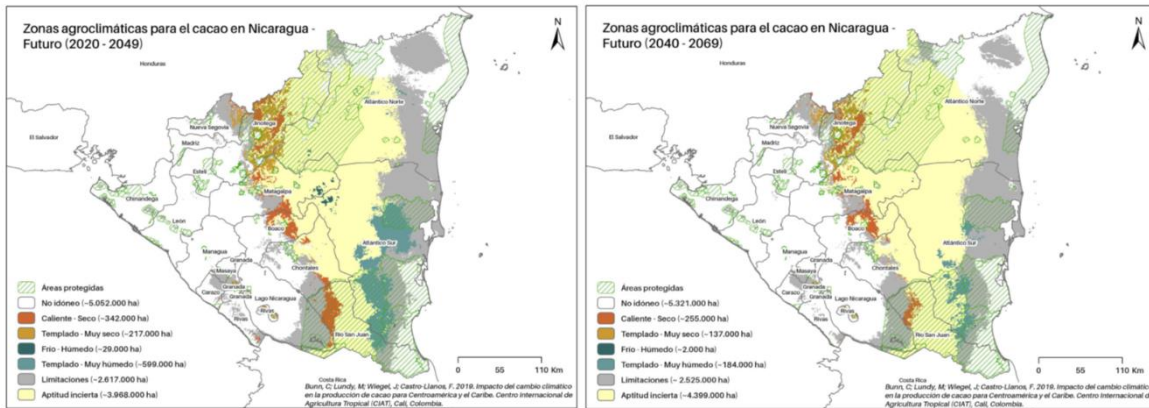


Figure 4. Agroclimatic areas for cocoa in Nicaragua - Future 2020-2049 (left frame) and 2040-2069 (right frame) (Bunn, et al., 2019).

Considering the published scenarios of climate change in the area, and the biotic and abiotic stresses in cocoa plants generated by the increase in temperature and rainfall, a substantial change in conventional production systems is recommended, towards a sustainable model that is adapted to the future climate. In the project area, a systemic adaptation is suggested (Figure 3), through the use of more adapted varieties, in combination with agroforestry systems, diversification, technical and financial support to favor the adoption of the new cocoa cultivation model.

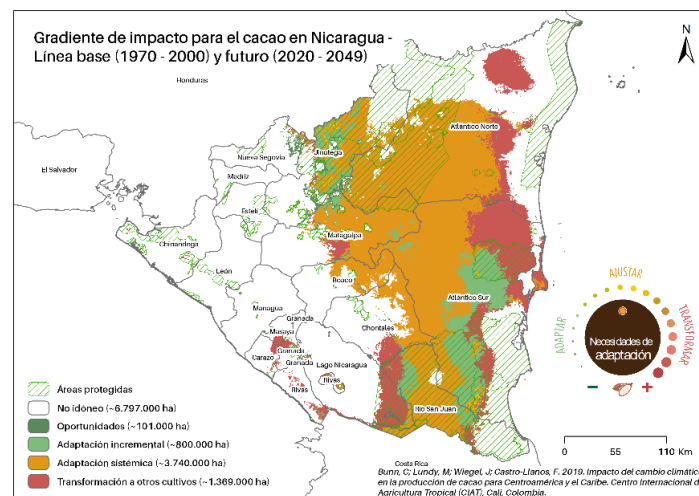


Figure 3. Gradient of impact for cocoa in Nicaragua (Bunn, et al., 2019).

c) Soil conditions

Soils suitable for cultivation range from clay to sandy loam. Clays have the ability to absorb water within their crystalline structure. Sandy soils, although they have a porous structure suitable for root penetration, lack good water retention, which is why they are not recommended for growing cocoa in regions with dry periods. In general, cocoa prefers soils rich in humic substances of uniform dark color, with a depth greater than one meter. These should be well drained soils, with good moisture retention capacity and good aeration.

According to the studies carried out by MAG and INTA in 2018 (MAG, 2018), the soils of the buffer zone have a variable fertility level, depending on their location. Six main indicators of soil fertility: organic matter, soil pH, available phosphorus and potassium, cation exchange capacity and percentage of base saturation were considered. The area of influence of the project has three different fertility levels: the area located to the west of the reserve and which includes the municipalities of Wiwilí and El Cua-Bocay has a medium level of fertility, the central part, consisting of the municipalities of Siuna and Bonanza, presents a low to medium fertility, while the Northeast area (municipality of Waspán) has a low fertility level. The results of fertility factors considered in the study of soil conditions are detailed in Table 1.

Table 13. Soil fertility levels in the area of implementation of the project.

	West zone (Wiwili-Bocay)	South – East zone (Siuna-Bonanza)	North - East zone (Waspán)
Organic Matter (%)	> 4 High	3 a > 4 Moderate to high	3 a > 4 Moderate to high
pH of the soil	5.2 - 5.9 Medium to strongly acidic	5.6 - 5.9 Medium acidic	5.2 - 5.6 Strongly acidic
Available phosphorus (ppm)	10-20 ppm Moderate	< 10-15 ppm Very low to low	< 10ppm Very low
Available potassium (Meq/100g soil)	> 0.4 High	0.3 - 0.4 Moderate	0.2 - 0.3 Low
Cation exchange capacity (Meq/100 g soil)	30 - 40 Moderate	15 - 30 Low	15 - 30 Low
Base Saturation Percentage	< 30 – 45 Very low to low	30 - 60 Low to moderate	45 - 60 Moderate
Soil Fertility	Moderate	Low to moderate	Low

d) Availability of areas suitable for cocoa

The most important climatic factors for cocoa are temperature and rainfall. They are, without a doubt, those that limit the areas for cultivation and are considered as the critical climatic factors for their development. INETER data indicate that the RACCN has an area of 3,4 million ha of land including 835,000 ha that are appropriate for cocoa (25%).

The potential area of implementation of the project is suitable for the cultivation of cocoa, through an adaptation of the conventional production system and pertinent management practices to achieve sustainable production and higher yields. It is considered to renew and rehabilitate the areas of abandoned grasslands with a slope 50% or less, with a potential cocoa cultivation area estimated to be bigger than 13,700 ha. Similarly, in the South-West part of the buffer zone of BOSAWAS (Wiwilí municipalities of Nueva Segovia, Wiwilí de Jinotega, El Cua, San José de Bocay), the establishment or renovation of the cocoa crop could be considered, especially in areas of altitude from 400 to 1000 m (Sousa, et al., 2019) which lost their potential for coffee (Figure 4, dark blue color).

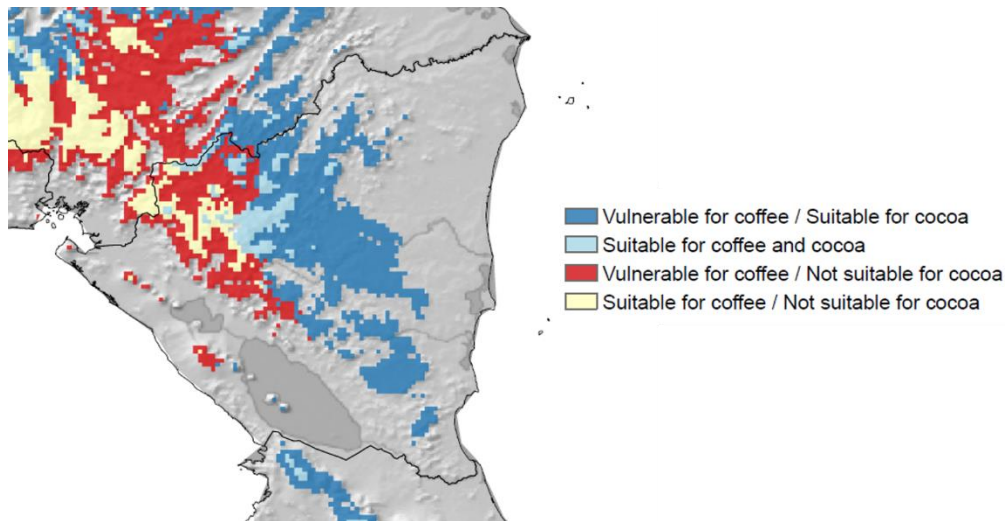


Figure 4. Potential area for the change of coffee with cocoa in a vulnerable area for coffee under climate change in Nicaragua (adapted from (Sousa, et al., 2019)).

2. Ecosystem

The BOSAWAS biosphere reserve presents a high diversity of ecosystems and some areas of great regional ecological importance that are still intact. In its buffer zone there are 4 protected areas: Cerro Kilambé, between Wiwilí and Cua-Bocay, the Peñas Blancas Massif in the Cua-Bocay, Cerro Banacruz, between Bonanza and Siuna, Cerro Cola Blanca in Bonanza and Saslaya National Park in the core area of the municipality of Siuna. The conservation of the fauna and flora of the area is of paramount importance for the conservation of the balance of cocoa crops, for the ecosystem services and functions of, among others, disease regulation, pollination, erosion control, climate regulation, potential crop production, flood damping, availability of clean surface water and groundwater.

a) Vegetation

According to the environmental map of Nicaragua (MARENA, 2011), the most represented ecosystem in the BOSAWAS protected reserve area is an evergreen forest, with three main variations: well drained evergreen forest; alluvial, moderately drained; and sub mountain. The reserve has three sites recognized for their endemic flora. On the other hand, the ecosystem of agricultural systems with 10-50% of natural vegetation represents the majority of the buffer zone. The most representative perennial cultivation systems are coffee and cocoa in agroforestry systems.

b) Native species of shade trees

The most commonly used species in conventional agroforestry cocoa systems are summarized in Table 2. Almost all trees commonly associated with cocoa in the project implementation area remain suitable for their use in agroforestry systems under the climate change scenario RCP 8.5. This scenario, known as the Representative Concentration Pathway 8.5, predicts the future greenhouse gas concentration pathway with a radiative forcing value of 8.5 W/m² in the year 2100. RCP 8.5 corresponds to a projected global warming increase of 2°C by 2065 and 3.7°C by 2100 (van Oldenborgh, et al., 2013). Under this scenario, the only tree variety whose use becomes not recommended in the area of implementation of the project by 2050 is the Cedro Macho (*Carapa guianensis*) (Sousa, et al., 2019).

Table 14. Characteristics of tree species most used in agroforestry systems with cocoa. Adapted from (MARENA, INAFOR, 2002) and (Sousa, et al., 2019).

Common name	Scientific name	Main use	Climate	Soil	Altitud	Adaptation to CC (RCP 8.5)
Caoba del atlántico	<i>Swietenia macrophylla</i> King	Timber	P > 2000 mm T > 24°C	Deep, rich in MO, well drained	< 1000 masl	Yes
Cedro Macho	<i>Carapa nicaraguensis</i>	Timber	P: 2000 – 4000mm T > 24°C	Clay-sandy, humid to swampy	< 500 masl	No
Cedro Real	<i>Cedrela odorata</i> L	Timber	P: 1200 – 3000 mm T > 24°C	Well drained	< 800 masl	Yes
Cortez o Roble	<i>Tabebuia rosea</i>	Timber	P: 1500-2500 mm T: > 26°C	All types	< 1000 masl	Yes
Coyote	<i>Platymiscium dimorphandrum</i>	Timber	P: > 2000 mm	Fertile, well drained	< 1400 masl	Yes
Granadillo rojo	<i>Dalbergia glomerata</i>	Timber Nitrogen fixator	P: 1500-3000 mm T: > 26°C	Well drained, deep	< 1400 masl	Yes
Guapinol	<i>Hymenaea courbaril</i>	Timber	P: 1500-2500 mm T: 24-29°C	Tolerates poor soil and drought	< 1500 masl	Yes
Laurel	<i>Cordia alliodora</i>	Timber	P: 1000-4000 mm T: 18-32°C	Texture loam and clay	<1500 masl	Yes
Madero negro	<i>Gliricidia sepium</i>	Nitrogen fixator	P: 900-1500 mm T: 22-30°C	Dry to humid, calcareous	< 500 masl	Yes
Naranja dulce	<i>Citrus sinensis</i>	Fruit tree	P: >1200 mm T: > 26°C	Loose and well drained	< 1300 masl	Yes
Pino caribe	<i>Pinus caribaea</i>	Timber	P: 1000-4000 mm T: 22-27°C	Low fertile, latosoles, well drained	< 1000 masl	No data
Banano, platano	<i>Musceae</i>	Temporary shade and fruits	P: 1000-2000 mm T: 15-40°C	Texture frank, fertile, well drained	< 1500 masl	Yes

c) Biodiversity

Cocoa agroforestry systems must preserve their diversity both at the structural level and at the floristic composition level: structural diversity, in the form of several plant layers, and floristic diversity, with the use of a wide variety of species, promotes connectivity at the landscape level, as well as the availability of habitats for birds and insects, which favor biological control of pests and services related to crop productivity such as pollination and seed dispersal (Schroth & Harvey, 2007). In addition, several positive impacts may be generated with the increase of biodiversity in cocoa trees, to enhance the conservation of soil fertility, nitrogen fixation, and sequestration of atmospheric carbon dioxide that contributes to

climate change mitigation. It is advisable to include in the agroforestry systems native species useful for producers, such as Mahogany (timber), native fruit trees, but also those species that benefit the fauna.

3. Socio-productive characteristics of the population

a) The family

According to the data from the 2005 Census, 97 % of the population of the BOSAWAS reserve recognize themselves as members of an indigenous people or an ethnic community (INIDE, 2005). However, it is difficult to specify the number of people who are cocoa producers and who have indigenous ancestry. In average, the age of the producers ranges between 45 and 60 years. Although there is a presence of young people, especially men, their participation is still not significant in cocoa cultivation activity (NICARAGUA COCOA SECTOR COMMISSION, APEN, SDC, 2018). Regarding the educational level, the government studies show that 36% are illiterate; 8% without any level of instruction, 42% report primary school; 19 % secondary school, and finally 2% have some university or technical degree (INIDE, 2005).

In general terms, the population of the RACCN is relatively young (48% is under 15 years old), with potential for work (both men and women). Family labor is available and the majority of the people are engaged in agricultural work.

b) Productive activities

National studies reflect that agriculture is the main productive activity carried out individually. Families work mainly within the municipality, and their main sources of income are crop production (87%), forest production (7%), and various smaller sources that include grocery stores, remittances, and other businesses (6%).

The main crops cultivated are: rice, yucca, corn, quequisque, beans, bananas, plantains, and malanga (also know as Taro root). In terms of area, families use an average of about 3.5 ha annually, which is a relatively small area mainly exploited for self-consumption, where they also grow citrus fruits (orange, lemon), coconut, avocado, mangoes, pejobaye, soursop, among others.

Other items of food importance for families are minor species or barn animals. On average each family manages 18 birds and 11 pigs for self-consumption and on a smaller scale for local commercialization. An average of 72% in all crops are destined for self-consumption and the surplus is sold locally (ECOM-GIZ, 2011).

The commercial use of wood is generally managed communally, under permission of the territorial authorities. However, some families take advantage of it individually, either for the construction of their own home, but also to commercialize and generate income.

c) Roles of family members in productive activities

There is a high dependence on family labor because of the lack of financial resources to hire external labor, and because of the large distance between plots. The family participates in a large range of tasks and activities: soil preparation, crop planting, management of the plot, harvest, and commercialization (sale of goods).

Men participate in all activities except for the commercialization and management of the garden (fruit trees), which is mainly carried out by women. Women can actively participate in almost all activities, except land preparation. The children of the family also participate actively in all tasks.

d) Experience in cocoa cultivation

Even though some projects such as PROGRESA CARIBE, PROCACAO, NICADAPTA have shown significant impacts in the improvement of the cocoa management in the area, in general, the experience of growing cocoa is still limited. This is mostly due to the focus of such projects on the areas boarding the principal roads, leaving outside the majority of the producers, who are located farther inside the territory and lack easy accessibility. Old and new producers have weak capacities to apply technological packages due, among others, to insufficient direct technical assistance to cocoa plots from cooperatives and public or private institutions (NICARAGUA COCOA SECTOR COMMISSION, APEN, SDC, 2018). The reports indicate that the dispersion of the plots and the lack of referents (model farms or guides to produce cocoa in the area) makes the practices in the field be done by approximations and homologations to practices of other similar crops like coffee.

Although there are experiences of change that are valuable, in general traditional practices prevail, for example, in cocoa sowing by seeds, with genetic material not specially produced for that purpose and with low quality. There is currently low productivity in production plots, very little rehabilitation of areas. Harvest and post-harvest works show localized experiences of technological innovation, especially where big projects PROGRESA CARIBE (RACCN), PROCACAO (Mining Triangle), and NICADAPTA (Matagalpa, Boaco, Madriz, Esteli, Nueva Segovia, RACCN, RACCS) were previously implemented.

e) Land tenure and territorial conflicts

The RACCN has territorial conflicts in the areas of Las Minas, Prinzapolka, etc. They have been exacerbated in recent years by massive migrations that have occurred in different periods (1916, 1957 and 1990) due to various causes. At present, the problem is exacerbated by the lax application of the territorial demarcation law of the indigenous communal lands, and for the widespread legal disorder of property, which in this area is much more complicated than in the rest of the country.

The destruction of natural resources and the environment, as well as the loss of communal territories have been the main causes of the emergence of conflicts. These property conflicts can be seen in two perspectives: i) from Western culture, based on private property; and ii) in indigenous culture, based on community property.

Data from 2005 report that 74% of the population born in the country and residing in each of the eight municipalities of the RACCN were born in the same municipality, showing very low migration. Just over 8% were born in a different municipality but in the same region, and the remaining 18% were born in another department or region of the country (INIDE, 2005).

C. Conventional cocoa production value chain in the region of implementation of the project

Currently, Nicaragua's cocoa value chain is made up of the links of inputs, production, processing (fermentation and drying), and commercialization (Figure 5). Each of them gather a number of key actors that have been playing a major role in the development of the sector, strengthened by institution providing research, technical assistance, certification, and financial support services.

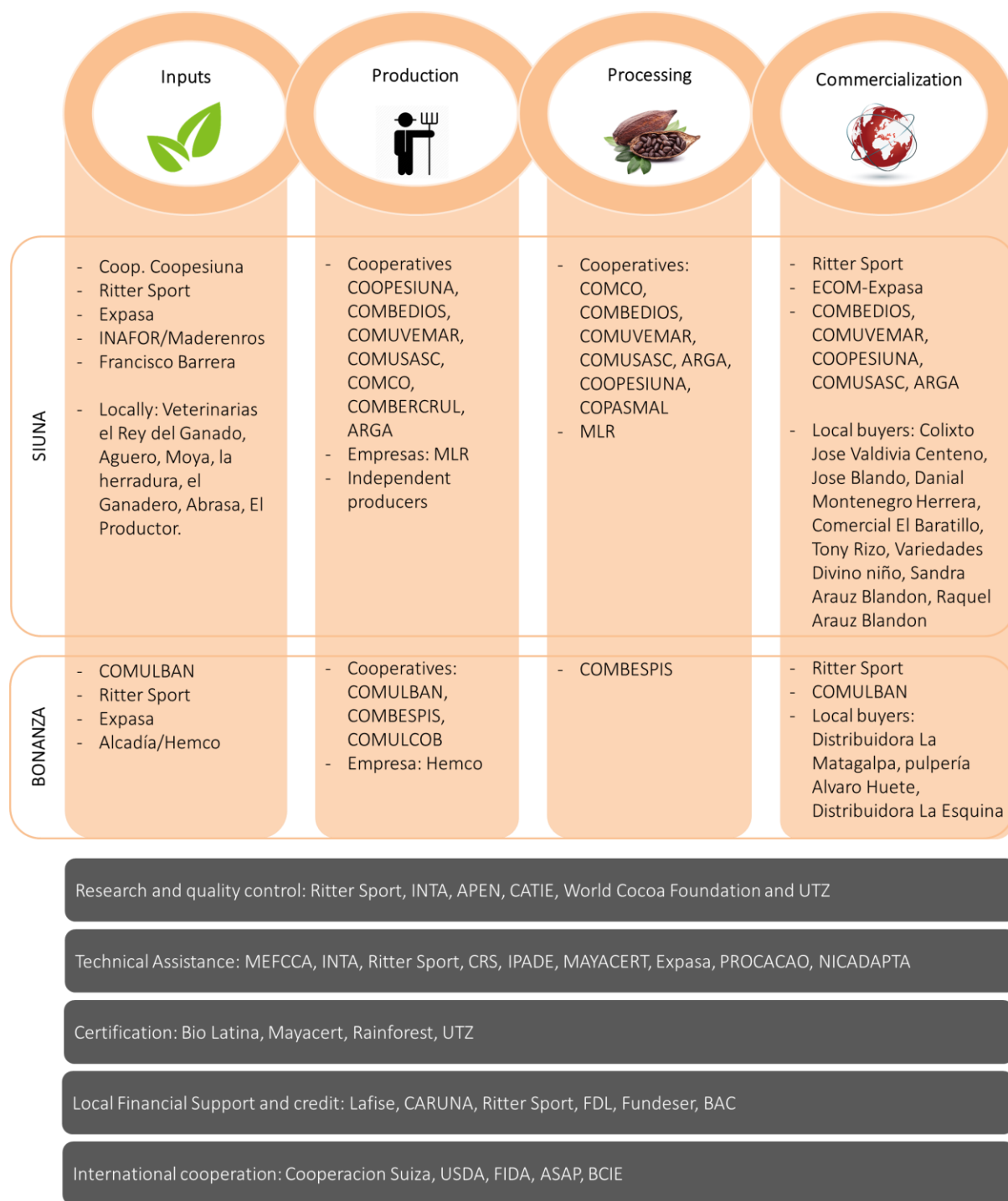


Figure 5. Map of the actors of the cocoa value chain in the region of implementation of Bio-CLIMA.

1. Inputs

The cocoa value chain counts three main types of inputs: cocoa plants, shade trees, and agrochemical inputs (fertilizers, herbicides, fungicides, insecticides).

a) Cocoa varieties

98% of the small producers' productive area have been established by seed harvested from neighboring trees (NICARAGUA COCOA SECTOR COMMISSION, APEN, SDC, 2018). However, through, PROCACAO and other projects have established areas with improved clones and a defined and prepared plantation framework, in order to improve the production yields of cocoa in the area.

The cocoa clones that have been introduced in the RACCN in order to improve the production yields are: CATIE-R1, CATIE-R4, CATIE-R6, EET-95, EET-96, ICS-95, IMC-67, PMCT-58, UF-296, UF-613, UF-667, and UF-668. Those that have been established in the clonal gardens in the cooperatives COOPESIUNA, COMUCOR and COMULBAN are CATIE-R1, CATIE-R4, CATIE-R6, EET-95, ICS-1, ICS-95, TSH-565, IMC-67, PMCT-58, UF-221, UF-676, GS-36, CC-137, and PACAYITA. These varieties were selected and provided by CATIE that introduced them in Nicaragua *via* the INTA's Experimental Center "El Recreo".

b) Shade trees

Cocoa is generally grown under very diverse agroforestry systems, with little planned designs but very rich in variety. The existing shadow is used or established according to different criteria.

The most commonly species found are musaceae and fruit trees such as: citrus, Chinese mammon, soursop, mamey, cashew, icaco, coconut, sapodilla, manzanitas, guaba, nancite, peach, acid guava, mango, caimito, pijibay, avocado, Creole mammon and achiote.

The most common shade trees are: laurel, guabas, mahogany, pochote, chaperno, cortez, granadillo, guapinol, pino Caribe and cedars. Other shade trees found in the cocoa plots are: acacias, areno, búcaro, llama del bosque, muñeco, carao, cerocontil, ciprés, cola de pavo, madero negro, ojoche, coyote, eucalipto, gavián, guano, guayabo blanco, macuelizo, tamarindo and teca.

Generally, the producer produce the shade trees himself in his home nursery. However, national nursery such the one of ECOM in Matagalpa can provide high quality forest trees clons.

c) Agrochemicals

In general, given the lack of resources, commercial agrochemicals are not used in small producers' farms, but the application of artisanal mixes made from organic waste is favored.

In the case of medium and large producers, or farms that are part of cooperatives, fertilizers, herbicides and pesticides are used at the basic level. The cooperative COOPESIUNA and the company Ritter Sport, have been the main suppliers of chemical products for cocoa.

2. Conventional production system

a) Socio-economic profile of small and medium cocoa producers

In the RACCN, planting prevails in small and medium-sized farms, in which fruits, coffee, corn, beans, among others are produced. In 2019, a total of 1590 producers are producing cocoa in the RACCN, whose 1040 are located in the region of Siuna, Bonanza, and Waspán, organized into 10 cooperatives (Table 15). The age of the producers ranges between 45 and 60 years and although the participation of young people especially men is registered, their participation is not yet a factor of identity with the crop.

Table 15. Number of cooperatives and producers (individual and organized) in the regions of Siuna, Bonanza, and Waspán.

Cooperatives	Producers (indiv. and organized)
--------------	----------------------------------

Siuna	7	740
Bonanza	3	221
Waspán	0	79
TOTAL	10	1040

In these territories, outside the recent investments developed by the three programs PROCARIBE, NICADAPTA and PROCACAO, there is a precarious production technology that is mainly characterized by the aging of the plantations. The producers that are not organized manage a technology that can be cataloged of low level, since there are only a few farmers who fertilize, prune, clean, manage and renew their cocoa.

In the RACCN, the area of cocoa in production is mostly in the hands of small producers and is managed by family labor, which, like the producers, has basic primary education levels, a factor that complicates the transfer of technology.

Cocoa is not the main activity in the farms of producers, whether associated or individual. The average cocoa area is not more than 1.4 ha. The plots are predominantly located in places distant from the property owner's home. This factor limits the constancy and quality of crop management.

b) Establishment and management of the crop

Currently in the RACCN, the region with the more extended area of cocoa is the Mining Triangle, that sums almost 6000 ha (Table 16). It is interesting to detail that in the Mining triangle, 39% of the new cocoa area is in the hands of only three large private companies (MLR, Kakau and Cacao Oro) that have a total of 3280 ha, and 61% is in the hands of small producers, organized or not into cooperatives.

Table 16. Area of cocoa in production in the different regions of RACCN.

Region RACCN	Hectares	%
Mining Triangle	5947	71%
Waslala	2107	25%
Mulukuku	164	2%
Waspán	124	1%
Prinzapolka	63	1%
TOTAL	8405	100%

In the farms of small producers, the plants are taken to the field and transplanted with a distance that can vary, depending on the topography of the area, and the arrangement of shade. It is common to observe a greater spacing between the plants, and a disorganized special arrangement attending to the search for ideal shade conditions, provided by pre-established trees (NICARAGUA COCOA SECTOR COMMISSION, APEN, SDC, 2018).

c) Productivity and quality

In the RACCN in general, and especially in the region of the Mining Triangle (Siuna-Bonanza-Rosita), cocoa production is increasing. During the last 3 years (2016 to 2019), cocoa production is expected to rise by a factor 7, due to the start of the production of the 3 large private companies MLR, Kakau, and Cacao Oro, which sum 72% of the total production of the area in 2019 (Table 17). In the Mining Triangle, in 2019, a total of 1190 producers produced 1662 MT of cocoa, while 3 big private companies produced 4211 MT.

Table 17. Projection of cocoa production growth in the mining triangle, according to data from (Nicaraguan Cocoa Sector Commission, APEN, SDC, 2018).

Producers	Year 2016 (MT)	% 2016	Year 2019 (MT)	% 2019
In cooperatives	474	53%	1007	17%
Individual	379	47%	655	11%
Private Companies			4211	72%
TOTAL	853	100%	5883	100%

The small producer's current average yields are 3.1 quintals of cocoa per hectare per year. The average cultivated area is 1.4 ha (Nicaraguan Cocoa Sector Commission, APEN, SDC, 2018). Both factors determine that it is currently not profitable to produce cocoa, mainly due to weak crop management, unproductive plants and areas with low plant density.

Currently, the production of small producers is not focused on potential areas, but rather shows a behavior that obeys the discretionary decision of each producer, since the implementation of public and private projects encourage the production of cocoa without a true criterion of territorial concentration, that limits the productive efficiency and the opportunities to develop producers and their families in an integral way.

d) Role of producer organizations

Cooperatives are the most present producer organizations in the area. Although they have weaknesses in the organization and empowerment of managers and partners, they have improved local dynamics to obtain greater productivity and cocoa quality with the help of third parties (public and private) (NICARAGUA COCOA SECTOR COMMISSION, APEN, SDC, 2018). They add value to the product with the processing, through a more controlled fermentation and drying. The atomized functioning of producer organizations does not favor the implementation of practices that would reduce costs and thereby increase marketing revenues. Even when they interact in some activities and receive accompaniments from the same providers, communication between them is limited and there are still no common elements for discussion, coordination and implementation of initiatives with a territorial focus.

3. Processing

Although in the RACCN small producers, independent and producers in cooperatives have recently established plantations by their own efforts, they usually apply conventional technology, where they do not carry out the processing of the cocoa, but instead, they spread the cocoa in drool in boxes or plastics. Normally this cocoa is not chosen, diseased or overripened beans are not eliminated, since the current local market (intermediaries) does not demand quality in this regard. In addition, they do not have a record and neither do they have a cocoa assistance program.

Situation is different for the producers that have received the support of one of the three main development programs and belong to cooperatives. In their case, the cocoa is processed in centralized collection centers. It can be fermented or not, and dried in African beds or directly on the floor. In the municipalities of the mining triangle there are eight processing centers in the hands of cooperatives (COMCO, COMBEDIOS, COMUVEMAR, COMUSASC, COOPESIUNA, ARG, COPASMAL, and COMBESPIS). It is estimated that approximately 1000 tons of cocoa are processed by these cooperatives in 2019, and some of them have managed to enter the formal market and European market with certification stamps.

It is important to highlight the establishment of a standard for quality by Ritter Sport. They have shared with their collaborators a list of criteria for the processing, taking into account the fermentation percent, number of beans not fermented, humidity of the beans, size of the beans, and presence of mold or infestation. This allows to guarantee and respect a certain level of quality, based on objective criteria.

4. Commercialization

There is a large cocoa market at local, national and international levels, and the leading organizations of the municipalities have a good knowledge of the existing markets, and have infrastructure to collect and process the cocoa (fermentation and drying). Competition is fierce, and for this reason, producer organizations have difficulty raising their prices as they are competing with non-formal intermediaries that sell at very low prices.

The cocoa trade is a business that generates good income, but usually the highest margins remain in the traders who have access to working capital and market for the sale of the product, but do not invest or risk in the production process.

a) National and international buyers

The main buyer and exporter of cocoa in the region is the German company Ritter Sport, the most consolidated cooperatives market their cocoa with this company. It purchased more than 3000 MT of cocoa in 2018, equivalent to 80% of the national export. It is worth mentioning the development of ECOM-Expasa, who in only 2 years of having positioned itself in the cocoa market, became the second largest formal buyer at the national level (150 MT) (Table 18). Then, the rest of the production is being sold to the national chocolate makers (Momotombo and Castillo del Cacao), the regional markets in Matagalpa (Gualuca) and Managua (El Mayoreo), other cooperatives and private companies.

The producers that do not belong to cooperatives sell their cocoa without fermenting with different intermediary buyers who do not demand quality and who pay similar prices to those paid by the cooperatives. The main buyer of this low quality – not processed cacao is the Gualuca market in Matagalpa.

Cocoa buying companies like Ingemann, Exportadora Atlantic, MLR are buying the cocoa in its pulp on the main roads of the municipality of Siuna.

Table 18. National cocoa buyers.

National buyers		Quality	Markets	Purchase prices (USD)
>200MT / year				
Ritter Sport	Formal buyer, Exporter	Fermented, dry	Intl	NYSE +300 to +400
<200 MT / year				
ECOM-Expasa	Formal buyer, Exporter	Dry red	Intl	NYSE +100 to +200
INGEMANN	Exporter	Cacao beans in the pulp	Intl	NYSE +500 to +1000
Cacao Bisiesto	Formal buyer, Exporter	Cacao beans in the pulp	USA	NYSE +1000
Ethiquable	Formal buyer, Exporter	Cacao beans in the pulp	France	NYSE +400 to +500
MLR	Private farm	Cacao beans in the pulp	Intl	n/d
Cacao Oro	Private farm	Cacao beans in the pulp	Intl	n/d
Kakau	Private farm	Cacao beans in the pulp	Intl	n/d
National chocolate makers	Chocolate maker	Fermented, dry	National	n/d

Cooperatives	Cooperatives	Cacao beans in the pulp	National	0.30 USD/lb
Gualuca market (Matagalpa)	Regional Market	Not fermented, red	Regional	NYSE -300 to -400

b) Prices and conditions

The two main stock exchange for cocoa beans are located in New York (The New York Stock Exchange) and London (London Terminal Commodities Market). These operate under two modalities, in current or physical markets and futures contracts.

The prices currently received by the producer for cocoa in its pulp are between USD 0.24 and USD 0.33 / lb (certified cocoa is paid between 6 and 10 % more). These prices depend on the fluctuation of the stock market price and the Guanuca local market prices in Matagalpa, governed by local buyers who purchase mainly unfermented cocoa ("red").

The price that the producer receives when selling its cocoa nationwide varies according to the degree of processing (in its pulp, fermented or dried) and according to the type of management that was given on the farm. There is currently a great price stimulus for producers to sell organic cocoa (CEI, 2013), that can reach more than 50% more than the market price.

c) Market access limitation

The main limitation of market access resides in the fact that there is little coordination and articulation among the cooperatives, even when they share the same territory. This dynamic limits the creation of strategic alliances for the collection and commercialization of cocoa by not taking advantage of economies of scale to reduce transport costs and increase the negotiation capacity with buyers and suppliers of inputs and services.

There are also weaknesses in the loyalty of producers in cooperatives, who take advantage of any circumstance to divert their harvest. This behavior compromises the ability of cooperatives to meet their delivery commitments causing a loss of credibility of the cooperatives as suppliers of a supply chain such as cocoa, and in turn it places them with a low bargaining power with the buyers as well.

Although there is a market of special cocoa microlots for its origin, taste (quality) and for being from small producers, this is a very small market with low expansion capacities. Therefore, both producers and organizations must deepen their knowledge about the dynamics of the international market and the reference prices of New York Stock Exchange, to negotiate prices according to the reality.

Currently, the designation made by the ICCO to the country of Nicaragua as a producer of fine cocoa is used to a minimum, and the marketing experiences that sell chocolate with origin (INGEMAN-ETHIQUABLE) are also scarce. However, APEN's initiative to create a national collective brand "Cacaos de Nicaragua" should be emphasized, with the objective of promoting the quality, taste and diversity of Nicaraguan cocoa in the world.

5. Current capacities of technical and financial assistance for the development of the cocoa chain in the territory

The challenge facing the production and productivity of cocoa in the RACCN involves the capitalization of interventions that are developed in the area, particularly the frequency and quality with which the small and medium producers are being serviced.

Technical assistance in the municipalities is insufficient, mainly due to the discontinuity of this service to the cocoa producer. Some workshops are organized with producers, essentially on the days of collection. The main topics are proper management of the plots, production and certification. In general, the current technicians in the best of cases, have their main experience in coffee management (NICARAGUA COCOA SECTOR COMMISSION, APEN, SDC, 2018).

An assistance based implementation directly threatens the sustainability of the intervention. The combination of subsidies and co-investment of the small producer is crucial to favor a greater sense of ownership in the management of technology and cultivation. There are financing experiences that the private company has developed with small producers that are worth deepening their analysis, making adjustments and perfecting the model to integrate them actively and jointly in the implementation.

The characteristics of the producers and of the production system itself are complex in the territories of Puerto Cabezas and Waspán, in particular since the levels of organization are practically non-existent. The 124 ha of cocoa that appear in the value chain were planted by different projects in recent years. These two municipalities do not have established or functioning cooperatives, they depend on the community management structure and the Regional Government of the North Caribbean that partially accompanies them technically (NICARAGUA COCOA SECTOR COMMISSION, APEN, SDC, 2018).

a) Government

The Government, through the NICADAPTA and PROCACAO programs, has favored the strengthening of the technical units of local producer organizations, and the governmental instances of agricultural research and health: INTA and IPSA respectively have given specific support and organized technical assistance visits to cocoa producers, focusing on Good Agricultural Practices (GAP) and recommendations for phytosanitary procedures.

In the municipalities of the Mining Triangle, PROCACAO and NICADAPTA have provided sustained technical support to 11 of the 15 cooperatives for their organization and operation, through training sessions and capacity installation.

b) Private Company

The technical business assistance of private nature has concentrated its collaboration in a client-supplier relationship. Its business model includes the development of its supply chain and therefore through its own programs provides technical assistance to producers and their organizations.

In this topic, the modality implemented by RITTER SPORT, ECOM and INGEMANN stands out. They provide support for the productive activity with connection to markets. They have concentrated their technical advice mainly on improving the processes of collection, processing and certification. RITTER SPORT pre-finances the collection of cocoa, and gives incentives for quality and volumes. ECOM has developed with small producers a model that promotes the establishment of plantations under AFS, through a financing modality that integrates the provision of high quality clones and forest trees, the financing of the labor, delivery of inputs, with frequent technical monitoring in the field.

c) Organization of producers

The most consolidated and large cooperatives offer basic technical assistance, but most of the time, this activity is subsidized by international cooperation. Normally, when projects end, the technical assistance is drastically reduced, generating little impact on the producers.

The approaches of the projects strongly prioritize the cooperatives. This implies that due to their low level of development and weak financial capacity for self-sufficiency, when being offered support, the actions of the cooperatives should align to external demands even when they have clearly needs.

d) NGOs

There are different national and non-governmental organizations such as ADDAC, UCA SOPPEXCCA, APAC, NITLAPAN and IPADE that arrive with a direct model to the producer generally subsidized by the cooperation. There is also presence of International NGOs such as CATIE, Catholic Relief Services (CRS), Lutheran World Relief (LWR), which have played an important role in supporting the governance of the value chain, especially in the production and processing networks, are also present in the territory. They have also introduced high productivity genetic material, and have given support with technical assistance services and training.

Additionally, organizations such as APEN, CATIE, World Cocoa Foundation and UTZ have supported research activities and quality management processes, and others like Bio Latina, Mayacert and Rainforest have promoted certification processes.

D. Costs, benefits and economic and financial indicators

See Annex.

E. Environmental impacts of the conventional production system

1. Loss of forests and associated greenhouse gas (GHG) emissions

Despite the conservation efforts of the BOSAWAS natural resource reserve, an average annual deforestation rate of 16,667 ha is estimated (MARENA, 2019), due to the advance of the agricultural frontier and the peasant penetration in the reserve (Walsh, 2000). It is estimated that forest loss is equivalent to emissions of 2.6 Mt CO₂e / year¹. The degree of deforestation that the region has been suffering in tropical rainforests has been relatively higher than in the pine savannas of the Caribbean.

2. In soils and water sources

The advance of the agricultural frontier, the deforestation and the establishment of pastures makes the soils prone to overuse and cause an accelerated deterioration, favoring erosion, threatening landslides and floods, and compromises the quality and availability of water for human consumption (FAO, 2018). In the areas deforested by the introduction of livestock, a degradation of the land due to the herds was observed, which results in compaction of the soils, making it an area very vulnerable to desertification. In addition, antibiotics and hormones given to the animals contribute to the contamination of soils and water sources.

¹ Estimation of CO₂ emissions based on calculations of emission factors based on the national forest inventory (INAFOR)

F. Analysis of the main opportunities and bottleneck of cocoa SAFs in the region

1. Main opportunities of the sector

a) High demand in cocoa

The national and international demand in cocoa is increasing. It is even more accurate for quality and certified cocoa, for which prices are rising. Nicaragua is a member of the ICCO, which recognize the country as producer of fine cocoa. By properly processing the cocoa, this could also lead to better prices.

b) Climate

In the BOSAWAS region, the climate change opportunities of cocoa do not lie in the opening of new areas suitable for cultivation, but in the disappearance of areas suitable for coffee cultivation, resulting in a change from coffee to cocoa by lack of competition with other crops (see Figure 4).

Moreover, the climate allow the growing of high quality cocoa (Criollo and Trinitario), which, when processed appropriately, allow for fine chocolate production.

c) The restoration of deforested landscapes

The restoration of degraded landscapes is a long-term process that allows the restoration of ecological functionality and improves human well-being. Through agroforestry, degraded landscapes can be rehabilitated and thus allow for better sustainability, resilience, restoration of biodiversity and ecosystems, guaranteeing at the same time environmental services, food and income in one of the most subject to deforestation areas in Nicaragua and with some of the highest levels of poverty (FAO, 2017).

d) The rise of the SAF

The function of cocoa in agroforestry system can be compared to that of a forest, although its structure and floristic composition are different. As a restoration tool, agroforestry systems allow combining the services of trees and perennial crops in soil improvement with the contribution of organic matter from tree pruning and tree and crop mulch (P. Läderach, 2013). In particular, cocoa SAFs can create forest-like habitats, which house biodiversity in rapidly degrading landscapes, in addition to providing a more stable economy for small producers (Kolavalli & Vigneri, 2011), and serve as wildlife shelters (Schroth & Harvey, 2007). At the landscape level, cocoa agroforestry systems maintain connectivity between different land uses, particularly in fragmented forests (Asare, 2016).

2. Limits of the cocoa sector

a) Organizational limit

The poor level of organization of the sector does not allow its effective development. Even if the three large project brought better quality plants, training and infrastructure, most of the producers are still not trained for running business, and their organization into cooperatives or association is limited. It is necessary to develop the collection and processing network in the region, to improve the quality of the cocoa and the market accessibility. Additionally, the producers do not have access to selected and improved genetic material which induce a low productivity.

b) Poor access to services

The technical assistance to producers' families is insufficient. The majority of the producers are not properly trained on technical aspects, production costs and knowledge of the cocoa business (especially production costs). Approximately 30% of the cocoa plantations that exist in the RACCN are unproductive areas, poorly designed and old, that receive a bad management of pests and diseases, and that is why

production is currently reduced by 25-30% (Nicaraguan Cocoa Sector Commission, APEN, SDC, 2018). It can also be added that the producer does not know management methods and products to combat monilia and black pod diseases, the latter being the most problematic. In the same way, the plantation is managed with a minimum investment due to the absence of financing mechanisms and financial products appropriate to the sector.

G. Conclusion: analysis of the sustainability of the conventional cocoa production system in the BOSAWAS area

1. Environmental sustainability

Given the history of these territories, conventional cocoa production is the product of a migratory and itinerant agriculture that deforested for exploiting wood, burning stubble and sowing transient crops such as corn, rice and beans in 1 to 3 planting cycles.

This migratory agriculture, which was also linked to the reduced capital of investment of the producers, is progressive. The soils provided with a thick forest cover that presents initially a high amount of organic matter and nutrients quickly deplete after a few years, giving way to the replacement of an old plot with a new one.

Although several cultivation practices have changed, this practice of migratory agriculture is still going on. In places located at the foot of mountains, some crops such as naranjilla (*Solanum quitoense*), pijibaye, coffee and cocoa are sown. The latter shows an uninteresting performance (3.11 quintals dry / ha, well below international standards).

The wild way of producing, due mainly to the low investment in nutrition, little shade management and diseases, with plantations established by seeds that were not produced for that purpose, in very low density plantation frames, makes this cocoa production model a system of low environmental impact on the plot itself, but a high impact on the environment due to the effects of the progression in the slash-and-burn practice in the search for more fertile land.

The producers that remain in this model do not have the capacity to increase their productivity through access to financing, technical assistance, or the knowledge to address a plan to improve productivity in a comprehensive manner.

Additionally, the government must encourage the care of forest areas and establish clear limits for the traffic of land and wood, given that greater migration could be unsustainable over time since more people are attracted which creates a greater pressure on the forest resource.

2. Social sustainability

Possession of a livelihood as important as land makes small farmers have an anchor to propel themselves. Family work in the support of the production unit is a mechanism that contributes decisively to the subsistence of the family, given the reduced economic income of the producers.

However, within the family's economic activity there is also the generation of income in kind or in food that is not monetarily recorded in the accounts of the producers (hens, plantain, pigs, cassava, basic grains, fruits etc.) that contributes in a sensitive way to diet stabilization.

Currently, cocoa is predominantly produced by smallholders, with an average area of 1 ha per producer. This area is insufficient to get out of poverty and turn cocoa into a leading product in their farms.

Finally, the low density of producers organized in cooperative (25%), added to the dispersion of their properties, limits the possibilities of exchange, price improvements, training, services etc.

3. Financial sustainability

Given the characteristics of the planting areas and the low yields of the conventional cocoa production system, it has no hint of favoring financial sustainability.

At the community level, there is currently very low financial availability, in cooperatives and associations, to finance inputs, to collect and to buy cocoa.

III. Feasibility study of a transformation model towards a cocoa in agroforestry system production model, for the restoration of degraded grasslands in the Bio-CLIMA project implementation area.

The region of implementation of the Bio-CLIMA project shows a predominant humid tropic climate, which makes this area suitable for the establishment of cocoa, having the challenge of increasing resilience to the multiple risks related to climate change that affects the crop.

A. Technical and management aspects

1. Presentation of the model

a) Characteristics of the model

This model of Cocoa in Agroforestry System (AFS) is based on local, learnings and vulnerabilities. Its configuration corresponds to the edafoclimatic characteristics of the territory and of the small producers. This initiative optimizes the use of the space available to small producers, estimated at 2 ha per farm, combining the introduction of high productivity cocoa clones, adapted to climate change, with local fruit and forest trees species, in grassland areas where sustainable management must be considered as a priority.

The model integrates the lessons learned from previous experiences developed by public and private actors, and locates its implementation in the BOSAWAS buffer area, particularly in indigenous or third-party lands, occupied with pastures in the municipalities of: Wiwili, El Cua-Bocay, Siuna, Bonanza, Waspán.

The investment of the Project to produce one hectare is USD 1,988, including technical assistance, supplies, basic tools, and labor for the establishment of the cocoa plants during the year "0". The inclusion of this payment is part of a strategy to reduce the risk that the plants will not be established in the required times and in the necessary conditions that guarantee optimum yields.

When possible, the implementation should be based on a cluster approach, which overcomes the ignorance or parallelism between actors, capitalizes and integrates anchor companies and producer organizations with their learning and potential; particularly those related to clone reproduction and technical assistance that progressively create the connection to markets (sustainable plantation management, cocoa collection, processing and commercialization).

It is expected to achieve the reforestation of 4,430 hectares, with cacao in agroforestry systems, implemented proportionally over five years, which would increase the capacity to accompany the establishment and with it the implementation of the practices defined for this activity. In the months preceding the establishment of the plots, it will be necessary to identify the families that meet the pre-established selection criteria, i.e. favoring young people and women.

Forest tree production will be assigned to community initiatives or to the farmer himself via on-farm plant propagation, while cocoa clones must be managed in a specialized manner to ensure traceability and quality through the certification of genetic purity.

This proposal for cocoa production seeks that the indigenous and mestizo families of the North Caribbean Coast Autonomous Region (RACCN) improve livelihoods, increase their resilience to environmental changes and natural disasters and achieve greater food security.

(1) Cocoa varieties, forest and fruit trees species

(a) High quality and productivity cocoa clones

The edafoclimatic characteristics of the area of intervention defined in the proposal, as well as the performance results of some well-studied clones, have set the standard for selecting the clones that are best suited for this project. The results of field trials conducted during the last 19 years by CATIE's Genetic Improvement Program (PMG) made it possible to select a group of six Trinitarian clones of good production and tolerance to Moniliasis: CATIE-R1, CATIE-R4, CATIE-R6, CC-137, ICS-95 T1 and PMCT-58. These clones meet a quality level consistent with the market demand, and high productivity under agroforestry systems.

To ensure the best performance of these clones, CATIE suggests that farmers who want to venture into cocoa production or renew their plantations, make use of these new materials from certified clonal gardens. These clones were distributed in Central America as part of the genetic strategy of the Cocoa Project of Central America (PCC) and other regional initiatives aimed at modernizing the plantations integrally, to improve the income and living conditions for the producers and their families.

In agreement with these recommendations, and the projects' quality and yield criteria, this proposal recommends the combined use of three high quality and high productivity clones: PMCT-58, ICS-95 and CATIE-R6. This triclinal arrangement reaches its maximum yield after 7 years, however, using grafting techniques the first harvest can be advanced as soon as year 2.

The biggest investment in this proposal is focused on the quality of plants. The model uses high productivity clones, resistant or moderately susceptible to pests and diseases common in the region such as Moniliasis and Black Pod (*Phytophthora* spp) (Table 19). These clones can be managed agroecologically, without demanding high investments of nutrients from external sources.

Table 19. Resistance and susceptibility of the selected clones to Moniliasis and black pod. AS: Highly Susceptible, MS: Moderately Susceptible, MR: Moderately Resistant, R: Resistant (Phillips-Mora, et al., 2012).

Clones	Moniliasis	Black pod
CATIE R6	R	MR
ICS-95	MS	MR
PMCT-58	MS	AS

This clonal arrangement produces a good amount of mucilage for the fermentation, which contributes to the grains acquiring fine flavors and aromas of quality. The size of the seeds ranges from 2cm to 2.6 cm, and the average number of seeds per fruit is about 27 to 35.

The growth strata of the three clones range from small, medium and tall in the productive stage. This generates self-shadowing within the plantation, the percentages of shadow range between 10-25%, which reduces the labor for shade management. To date, no information is found on the level of accumulation of cadmium in these clones and their rootstock.

The potential providers in the area are COOPESIUANA, MLR, CACAO ORO and Exportadora Atlantic S.A. (EXPASA).

(b) [Forest species](#)

The model includes the incorporation of native species that can be taken from the natural re-generation of smallholder plots. It is recommended to define community modalities for the production of plants that retain learning and improve local skills and thereby reduce costs.

In the cocoa agroforestry system, it is recommended to choose native species with low management requirements, with high regrowth capacity after pruning, resistant to pest and diseases. The recommended trees have deep roots that do not compete with the roots of cocoa, which also allow them to capture nutrients from deep within the soil.

It is essential to manage a shadow percentage below 50% to allow a good development and production of cocoa, mainly during the main flowering season and during the months of high cloudiness and humidity. Excess shade increases the ambient humidity and favors the development of diseases.

For the fixation of carbon, it is important to establish forest species whose behavior is characterized by rapid growth, high density and hence greater capacity to capture carbon. The recommended species would be, among others: *Tabebuia rosea* (the cortez), *Cordia alliodora* (the laurel), or *Platymiscium pleiostachyum* (the coyote) for their ability to capture carbon and their timber character, and *Gliricidia sepium* (blackwood) for its high nitrogen fixation capacity.

(c) [Fruit species](#)

Fruit tree species such as orange, lemon or avocado could be considered beneficial for the project. It is advisable to choose fruit species based on the demand of the producer and the potential markets in the area.

(2) [Establishment of the cocoa in AFS](#)

(a) [Auto and inter-compatibility specifications of the clones](#)

The cocoa plantation will be established in a triclinal arrangement (CATIE-R6, ICS-95, PMCT-58), which are inter-compatible for pollination. The combination of clones avoids the problems of genetic incompatibility, favoring that a percentage superior to 90% of the plants is productive.

The following Table 20 details the auto and inter-compatibility of the three clones of the model:

Table 20. Matrix of self and sexual inter-compatibility of the 3 clones (Phillips-Mora, et al., 2012). (+)Auto-compatible; (-) self-incompatible; (++) inter-compatible (> 30%); (-): inter-incompatible (<30%).

Female / Male	CATIE-R6	ICS-95	PMCT-58
CATIE-R6	-	++	++
ICS-95	++	+	++
PMCT-58	++	++	-

(b) [Spatial and temporal arrangements of cocoa with varied shade](#)

The design of the model guarantees a better use of space, helps regulate the temperature in the plantation, moderates the entry of light, decreases the effect of the wind and at the same time protects and improves the soil.

To guarantee high productivity and to promote biodiversity in the farm, it is recommended to establish the following for each hectare:

- 816 cocoa plants at a distance of 3.5 x 3.5 m, that is 272 plants from each selected clone,
- 816 musaceae plants interspersed at 3.5 x 3.5 m as a form of temporary shade,
- 51 forest trees at 14 x 14 m,
- 51 fruit trees (sweet orange, lemon) on the perimeter of the plot,
- 2.5 kg at the stroke of Canavalia bean, Caballero bean, or other short-cycle crop.

Ideally, the musaceae should be established in the months of March-April, the year before the planting of cocoa, to guarantee shade at that time. By eliminating the musaceae, forest trees are established, remaining for 20 years on the plot to ensure efficient carbon capture.

The recommended arrangement for slopes below 25% is in the shape of a square. On slopes between 26 to 50%, the planting distance is the same, however, the sowing frame is in triangular patterns, to avoid erosion problems.

The family could optimize the space in years 0, 1 and 2, establishing cocoa plantation in combination with short-cycle and semi-perennial crops, with superficial root systems that do not compete for nutrients with cocoa (for example, gandul bean, yucca, corn). In addition to ensuring food security, crops such as Canavalia beans, Caballero beans and Terciopelo beans are organic nitrogen sources, favorable to cocoa plantation in the context of impoverished and low fertility soils due to deforestation and grazing.

(c) [Live fences](#)

Fruit trees will be established as living fences, at the perimeter of the plantation and at a distance of 6 to 10 m.

(3) [Agroecological management and practices](#)

Due to the funding limitations, agroecological management was chosen, without the use of fertilizers, pesticides or commercial herbicides. Agroecological practices should benefit from the natural resources present in the area, such as the use of short cycle crops in the first 2 years (beans), organic nitrogen source, composting fertilizers and cattle manure. Pruning of branches and tree mulch will be used as a contribution of organic matter that helps with soil improvement (Estrada, et al., 2011).

b) [Expected quality and volume](#)

The triclinal arrangement is composed of clones of high organoleptic quality. Starting from values around 400 kg / ha at the third year after sowing, CATIE-R6 reaches 2,900 kg / ha / year at the ninth year, which are considered as its age of productive maturity. The PMCT-58 and ICS-95 have similar productivity, with better production after year 7, which can reach 1,400 kg / ha / year. The average yields of each clone are detailed in Table 21.

Table 21. Proposed clonal arrangement and expected yield per hectare (Phillips-Mora, et al., 2012).

Clones	Plant number	Yield kg/ha/year (average 11 years)	Yield kg/ha/year (average 7+ years)
CATIE-R6	272	1,485	2,363
PMCT-58	272	789	1,036
ICS-95	272	636	926

Triclonal arrangement	816	970	1,442
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2. Characteristics and criteria for the selection of the beneficiaries

a) Success criteria for the adoption of the model

Producer organizations and existing territorial organizations in the territory of influence must understand the philosophy behind this proposal, the goals, the expected impact, the work methodology, and the selection criteria. This is a key factor to ensure a successful implementation. Leaders must clearly manage that the priority areas of interest are degraded grassland areas and that the impact is intrinsically associated with territorial concentration.

b) Characteristics of the farms

Farms are usually diversified for family support, with livestock (beef and dairy), basic grains (beans and corn), musaceae (bananas and plantain), small livestock (chicken), coffee, chili and passion fruit, in addition to cocoa.

These farms are small productive units, smaller than 7 ha, of which 2 ha could be destined for cocoa. Generally, cocoa in these farms has low production yields mainly due to the low investment in fertilization, poor shade management and high diseases incidence. Additionally, plantations were established with seed in very low density plantation frames, which lead to lower productivity.

The selection of producers will be carried out based on the following pre-established criteria: i) actively participate in socialization and training workshops, ii) own at least 2 hectares of land suitable for cocoa cultivation, iii) sign agreements with the commitments of the Project.

The identification and selection of participants that comply with the indicated requirements will be in charge of community leaders.

c) Differentiated affirmative measures for young people and women

Women, particularly young women, will be subject to training processes for the establishment of enterprises that will be in charge of the reproduction of forest and fruit trees with modern techniques. Women, who are also land owners will be prioritized to enter to the project.

d) Emphasis on indigenous and Afro-descendant territories

In the identification of potential beneficiaries, territorial authorities will have a very important role in indigenous territories because it is imperative to achieve areas as compact as possible and thereby leverage the generation of impact in terms of density and visibility.

Indigenous peoples own the largest amount of land and therefore it is crucial to capitalize on the relationship they have with the land and its resources.

B. Economic and financial aspects

1. Establishment and production costs

The main investment (95%) of the project will be made at the establishment stage. Genetic material of highest quality will be used, reproduced under strict standards that guarantee genetic purity. In that sense, 816 grafted cocoa tree per hectare will be delivered, which constitute 82% of the investment per ha. The decision to use grafted cocoa trees is justified by the interest of advancing production to year 2, considering the establishment as Year 0. Since the area of implementation is very large, transportation is included in the cost of the plant.

The second item that has the highest cost in the budget is the payment of labor, to carry out pre-planting and planting work. The fundamental interest of this item is to guarantee an establishment according to the defined standards, which is crucial for the impact of the program in general.

For the management of the plantations, a minimum financing of the project is considered, for the control of the shoots. This work is critical when grafts are used, to prevent rootstock from developing and therefore generate a negative impact on productivity and quality.

Regarding inputs, an agroecological management system that promotes the non-use of agrochemical inputs such as fertilizers, herbicides and insecticides was selected. The only product that is included is the triple CAL, whose properties favor the control of the acidity of the soil. This function favors the absorption of Nitrogen, Phosphorus and Potassium that is found naturally in the soil. The triple CAL application is planned for years 0, 1 and 2.

2. Costs of technical assistance and monitoring for the adoption of the producers of the transformation process.

a) Training and workshops

Due to the fact that the actors in the productive chain face challenges of organizational, managerial and market gaps, this program must carry out a training program for the leaders to develop the necessary skills to implement the plans and strategies that have been generated with previous interventions.

Training for small producers is more beneficial through internships, field days and technical support group sessions. The idea is to use the available experience so that they can observe and perform the management techniques. Anchor Companies located in the area can play an important role in this modality.

Similarly, women will be subject to a training and accompaniment process that enables them to develop skills in the management of modern plant reproduction techniques and in the management of group dynamics with common purposes.

It is important to develop alliances with educational entities specialized in the qualification and certification of training that could deliver a certificate or diploma.

b) Technical Assistance

It is considered of capital importance to include technical support for the establishment of 4,430 ha. This technical assistance in the first year (year of establishment) implies monthly support for planting and training in the implementation of Good Agricultural Practices (GAP). Through its technical assistance, the project will especially promote the use of biological methods to control the pests and diseases, as well as the weeds. It will particularly encourage an adequate use of fertilizers, and will support the implementation of methods such as manual weeding, and the use of biological products and traps in alternative to chemical pesticides, fungicides and herbicides. After the second year, the Technical Assistance will acquire a punctual behavior. It will be reduced to 2 annual visits in year 2, and one visit in years 3 to 7. Budgetary provision of an annual amount of USD 50 per ha is planned for the 1st year. For year 2, USD 20 is included and USD 5 is preview for years 3 to 7.

In the implementation strategy, it is recommended to explore the option that the private companies that have experience in plantation management, with installed capacity and technical expertise, can attend

producer routes with technical assistance, training and commercialization. This negotiation must be fine-tuned, in order to safeguard the interests of small producers.

c) Commercial technical support

No specific amount for this work has been included in the budget, so it is recommended to develop it through alliances that capitalize on the specific experiences of private actors with interests at stake.

d) Monitoring

The monitoring and control of the agronomic management of the plantation will be assumed by the Technical Assistance, with clear indicators and periodicity to report it. This activity, like the previous one, has no specific budget assigned.

C. Target markets, access support mechanisms and their costs

Nicaragua has a cocoa chain with little added value, since the form of export is mainly in grains. Only one third of the production is exported as high-quality cocoa and, although some progress has been made, there is still a need to put more efforts in increasing the collection volumes, upgrading processing capacities and fermentation and drying protocols from better quality products.

Additionally, the international market puts in place demands that until now have been only met by external actors, in the field of certification of plots, the implementation of good manufacturing practices, improved drying infrastructure and standardized beneficiary protocols according to the markets. It is necessary to move towards those requirements to be able to compete against other cocoa producing countries in the region.

1. Quality, uniformity, reproducibility, and flavor

Quality, uniformity, reproducibility, and flavor are key characteristic to achieve added value. The standardization of fermentation and drying protocols is a challenge that needs to be overcome to maintain the quality of Nicaraguan cocoa and preserve its natural flavor. These protocols should be managed as country protocols, adapting them to those demanded by the market, to achieve the consistency that the market requires. The project does not intend to develop new protocols for this, and in case of not having its own protocol, it is suggested to apply the protocol developed by Ritter Sport.

The novelty of the use of yeast at the time of fermentation (Lalcacao marketed by Lallemand for example) aims to guarantee the uniformity and reproducibility of cocoa product, in addition to positively impacting its flavor. Its potential use could be driven by one of the large buyers (Ritter Sport, Ingemann, ECOM-Expasa) or large farms (MLR, Kakau, Cacaooro), in collaboration with small cooperatives.

2. Certification

Certification and ecological and organic labeling schemes are an opportunity for producers to demonstrate and promote the sustainability of their production systems. Certification systems verify that production standards are being respected (i.e. voluntary sustainability standards), and labels adequately communicate to the final consumer the environmental and social characteristics of a determined product.

The valorization of efforts to attain sustainability in an integrative manner could be achieved through a tandem certification strategy: for the production of sustainable cocoa and at the landscape level (Table 22).

Table 22. List of double-scale standards for the certification of sustainable cocoa production at the landscape level (Somarriba, et al., 2013).

Standard	Mechanism		Elements			Online source
	VCM	CDM	C	S	B	
The climate, community and Biodiversity Alliance (CCB)	X	X	X	X	X	http://www.climate-standards.org/index.html
Verified Carbon Standard (VCS)	X		X			http://v-c-s.org/
The gold standard	X	X	X	X	X	http://www.cdmgoldstandard.org/
Social Carbon Standard	X		X	X	X	http://www.socialcarbon.org/
Forest stewardship council (FSC)	X		X	X	X	http://www.fsc.org/77.html
American Carbon Registry Standard (ACRS)	X	X	X	X	X	http://www.americancarbonregistry.org/
Carbo Platinum Carbon Standard	X		X	X	X	http://www.cquestor.com/
Carbon Fix Standard (CFS)	X		X	X	X	http://www.carbonfix.info/
EPA Climate Leaders Offset Guidance	X		X			http://www.epa.gov/
Panda Standard	X		X	X	X	http://www.pandastandard.org/
Plan Vivo	X		X	X	X	http://www.planvivo.org/standard/
VER+ Standard	X	X	X			http://www.tuev-sued.de/
Chicago Climate Exchange (CCX)	X		X			https://www.theice.com/ccx.html
Green-e Climate	X		X			http://www.green-e.org/
WRI/WBCSD GHG Protocol for Project Accounting	X	X	X			http://www.ghgprotocol.org/
Rain Forest Alliance	X	X	X	X	X	http://www.rainforest-alliance.org/

VCM: voluntary carbon markets; CDM: clean development mechanisms; C: carbon; S: social impacts; B: environmental impacts (biodiversity, land use, reforestation).

To achieve a better impact, certification through cooperatives or buyers is recommended, and should be part of the technical assistance provided to the project during the first two years.

3. Description of the target markets and market access

The constant increase in demand opens a real opportunity for Nicaraguan cocoa in the international market. In 2018, Nicaragua exported 3,886 tons of cocoa, worth 6.3 million dollars. The average export price has been USD 1,600 / MT, which continues to show that regional exports are done at prices well below the New York stock market (USD 2,300 / MT).

Cocoa produced in an agroforestry system with agroecological practices aims to reach adequate markets, with prices according to the quality of the bean, and with policies that favor the development of the sector. Two types of potential markets are considered: conventional and niche.

The niche markets of high quality cocoa with socio-environmental responsibility are an opportunity for this value chain in the country, since competing for volume can be widely surpassed by other countries. However, niche markets require very high quality, certified cocoa, and could be considered only in specific cases according to the disposition and capacity of the producer to face such demands. On the other hand, the conventional market allows to sell larger volume and does not require sophisticated management practices, which makes it attainable by most producers.

a) Conventional markets

Of the two models of conventional market: "producer – organization – formal market", and "producer – informal market", the first one generates more benefits (Nicaraguan Cocoa Sector Commission, APEN, SDC, 2018). It is recommended to work with an intermediary organization such as a cooperative or a producer association, which has the advantage of having agreements with buyers and can support the obtention of certifications. Cooperatives buy the product in the communities and assume the logistics. In addition, they also buy at fixed prices, in line with the prices negotiated with the buyer company. The cooperatives present in the project's implementation area are: COMUCOR, COMULBAN, COMBEDIOS, COMUVEMAR, COMUSASC, COOPESIUNA, ARG, COMBERCRUL. R. The three largest buyers / exporters in the country are: Ritter Sport, INGEMANN, and ECOM-Expasa.

b) International niche markets

Niche markets are very limited markets and it is necessary to understand the dynamics of the international market (especially the price of the New York Stock Exchange) to negotiate prices according to reality. In collaboration with cooperatives and institutions, it is recommended to look for niche markets with special cocoa origin, for aroma (quality), for being from small producers, for their sustainable production, for their ethnic diversity, for their conservation, for their recognition of the indigenous people, or also for carbon sequestration.

The country's status as a producer of fine cocoa given by ICCO could also be exploited. The names of places can be used as a commercial name for marketing, according to the example of INGEMANN using Waslala, as well as ETHIQUABLE that has been positioning the Waslala cocoa in the French market.

At a national level, the experience of niche markets that can be replicated are those of INGEMANN, chocolates Momotombo, choco Atelier and CACAONICA, that have worked with a special arrangement of flavors, which have allowed them to receive awards and recognitions internationally, positioning themselves in niche markets where each of them has specific protocols for its customers.

To access these types of markets, it is recommended to work with groups of producers, with fermentation protocols developed according to the requirements of the buyers. Marketing and commercialization can be boosted by taking advantage of events such as the Salon du Chocolate in Paris, to advertise a selection of cocoa from the producers in the project area.

(1) Ethnic market

The cocoa originating from the lands of the indigenous and mestizo peoples could be valued as an "ethnic product", due to its characteristics of being produced with ancestral protocols, with native raw materials, and handcrafted production. In Nicaragua, there is no known initiative of this kind in the cocoa sector.

(2) Sustainable production

For consumers, good chocolate is not just a matter of taste, quality and price. They also require that it has been prepared respecting people, the environment and they expect manufacturers to be able to demonstrate that production is responsible, for example, through adequate and moderate use of fertilizers and pesticides, schooling the children of farmers instead of making them work, providing decent housing, health and training to agricultural workers, and professional training to producers, with access to market information and facilitating their relations with buyers.

Considering all of the above, sustainable and transparent cocoa production in agroforestry system could be used as a marketing argument. In alliance with national institutions, private companies and cooperatives, the environmental benefits of cocoa could be promoted in special markets, for its production under agroforestry systems, for being part of a reforestation plan in buffer zones of protected areas of national interest like BOSAWAS, for the maintenance of biodiversity and for the recovery of tree cover in previously deforested areas.

A similar initiative could be the one of ETHIQUABLE that promotes social sustainability with "fair income in an area marked by civil war [Waslala]" (Ethiquable, 2019).

(3) Bean to Bar

In some cases, manufacturers will establish and maintain direct contact with producers, or even buy directly from the farm. There is a Bean to Bar initiative in Nicaragua: Cacao Bisiesto, which offers high

quality cocoa beans, carefully fermented and dried with identifiable terroir, and prices higher than those of the international market (Bisiesto, 2019).

c) Promotion of Nicaragua's cocoa

As part of the technical support, the Project will promote sustainable cocoa farming, aimed at agroecological agriculture, where cocoa produced respecting the following values can be promoted:

- Producing cocoa with more sustainable techniques for the family, the community and consumers (agroforestry systems),
- Valuating the knowledge of the producing families and recognizing their efforts,
- Selling cocoa at a fair price,
- Working with minorities (indigenous peoples, mestizos, youth and women),
- Caring for the environment with carbon sequestration, protection of natural resources such as water, air, soil, and biodiversity.

The promotion of Nicaraguan cocoa could take advantage of national and international fairs such as the International Cocoa Congress in Nicaragua, the Salon du Chocolate in Paris, and the Chocao gastronomic event in the Netherlands, to present their best products and to allow them to identify new potential buyers.

To promote and position Nicaraguan cocoa at the international level, the collective brand "Cacaos de Nicaragua, from tradition to the future" was launched in 2017, promoted by the public-private alliance, where APEN played a leading role.

d) Strengthening of marketing and commercialization capabilities

Despite the efforts, it is necessary to work together: government, guilds and companies; following pre-established strategies in the national cocoa culture plan to promote sustainable development in the value chain, seeking the consolidation of established markets and opening new ones, without losing the road map of Nicaraguan fine cocoa.

The prices obtained must reach the producer so that, at the time of selling their cocoa, the price received is attractive and it values the importance of quality. The mere fact of producing this type of cocoa should give it an added value, for which price should be negotiated based on the requirements of the buyer. In this way, the competitive advantage of the producer can be strengthened or created.

To strengthen the marketing and commercialization capacities, the main lines on which the Project would have to work in priority, through technical assistance, field tour and training are:

- Strengthening of cooperatives

Main intermediaries between producers and trading companies, cooperatives have a key role in the value chain. The strengthening of its capacity for collection, processing, and commercialization, as well as the development of its corporate vision of social inclusion would have a considerable impact on the value chain. The strengthening of its technical assistance service should be oriented to favor the loyalty of the producer with its cooperative.

- Volume and quality

A major component in technical assistance and training for small producers should be aimed at improving the volume and quality of cocoa, through increased productivity per hectare, the use of plants with better

genetical characteristics, compatibility, and management according to Good Agricultural Practices. It will seek to intensify the plan to replace old cocoa plantations that have not been rehabilitated, and determine geographical areas where it should be grown, which should respond to scientific studies that have zoned the ideal geographic areas for this crop.

Later on, INTA and other state institutions could be used to permanently give seminars to farmers through the “field schools” methodology. This could help improve the current production yield of 4 quintals per hectare, considered one of the lowest in the world.

In terms of quality, it is necessary that the government establishes standards, to (i) control the quality of the cocoa that is exported and avoid mixing the fine aroma cocoa with the bulk / red cocoa, a mixture that is causing harm to the Nicaraguan farmer, and (ii) control the levels of heavy metals, Cadmium in particular, and pesticides at the time of export, to avoid reaching the maximum levels indicated by the EU in its new regulation 488/2014 that was enforced since January 1st, 2019.

- Transparency and traceability

The marketing of cocoa faces the problem of “intermediaries” and informal markets, which are the people who buy “at the foot of the farm”, paying in cash, but at lower prices, which in many cases do not even cover the production costs. They resell the cocoa to other intermediaries, who in turn sell the cocoa to exporting companies. Working with organized groups and cooperatives will give an organizational and commercial leap that would benefit the sector.

- Consistency

A quality-consistent volume would have to be consolidated, to avoid loss of credibility of cooperatives as suppliers of the cocoa chain, and to improve their negotiating power with their buyers.

- Access to credit

The creation of low-interest credit lines (5%) generated by this program (see D.4), poses advantageous conditions for small producers who will benefit from it. The fund that will be recovered would be allocated to cooperatives that achieve better performance proportionally to their participation. This fund would capitalize the organizations and leave an amount available to reinvest in either the same or other small farms.

It is important to highlight that the exporting and cocoa production companies can, in the middle and long term, play a role in facilitating access to financial services adjusted to the needs of small producers, through strategic alliances with local producer organizations.

- Certification

Cooperatives and groups of cocoa farmers should encourage Nicaraguan cocoa to have international certifications, in order to ensure that producers receive a fair price for their product.

e) Potential Buyers in Nicaragua

In order to reach decent prices, it is recommended to target buyers that reward for the quality of the processed cocoa. Local buyers such as Ritter Sport, Expasa, Ingemann, Cacao Bisiesto, etc., usually buy cocoa at prices superior to the NYSE prices. By selling their processed cocoa to these buyers instead of the

non-official intermediary buyers, that buy not fermented and red cocoa, it is expected for the producers to sell their production about 5 to 10 times more expensive.

D. Institutional arrangements and instruments necessary to support technical, financial and market access.

When the main obstacles to the adoption of small producers are analyzed, the following barriers top the list: inaccessibility to credit, unreachability of technological innovation, insufficient knowledge and atomization. Within the framework of this proposal, territorial dispersion and a certain parallelism in public-private and private-private actions can be added, even when the different entities share interests.

Credit is an instrument that, when managed intelligently, can favor development and sustainability, which are two key factors to curb and mitigate the damage that has been inflicted to the BOSAWAS Reserve area. Ensuring that this fund effectively learns from the lessons that other local initiatives implemented is vital to achieve development and sustainability.

1. Establishment of a trust

The execution of this proposal supports its strategy in the use of a trust for the credit management. It would be managed by the Technical Unit (TU), within the framework of national laws and regulations.

The trust will be constituted with the project funds, equivalent to 75% of the value of the investment made by the Program in cocoa plants, which will be reimbursed by small producers (USD 1,224 per hectare). This fund will be transferred to the producer organizations to capitalize on them and favor their investment and replication capacity to expand planting areas with the same producers or incorporate others.

It is recognized that the main impediment to achieving the proposed objectives are the governance risks, related to the execution capacity of local organizations (cooperatives). If the execution rate is too slow, it would influence the performance of the portfolio, hence that the program through the TU will also act as a direct funder and as an accompanying capacity developer for the organizations of implementing producers.

The accounting and control of the Trust will be officially carried out by the TU who will also manage the records. This financial mechanism for the implementation of new areas is based on a ten-year loan, with an annual interest rate of 5%. The planting of 4,430 hectares of cocoa in agroforestry system will be done from the first year, under an incremental modality in similar quantities. The small farmer will sign a document specifying that his debt will be reimbursed through a carbon credit that will be paid to him in exchange of the reforestation of his farm, and where he commits to the restoration of his land.

This mechanism will finance each small producer for the planting of 2 new ha of cocoa in agroforestry system. The participant's commitment is initiated in the third year of the program, when the cocoa trees start producing, and the amount of carbon captured by the forest and fruit trees is significant enough for the small producer to start receiving a payment for the carbon captured. The reimbursement of their obligations will be through the payment received for the carbon captured through the establishment of cocoa in agroforestry system, as well as the annual delivery of 30% of their production of cocoa bean in its pulp to pay off the debt acquired for planting cocoa plants plus interests. Obtaining a critical area of land planted in the first year also means that farmers will be able to start paying the cost in year 3 and conclude it when they payback the sum due, including interest.

In the first 7 years, the fund would cover the cost of developing 4,430 ha of cocoa, training, supervision, monitoring and training of 2,215 producer families (2 ha per family). After this first phase with 2,215 farmers, the availability of the fund will be restored with farmers' reimbursements, the second phase farmers can be selected under the same scheme (participation in training and loyalty in fulfilling delivery commitments) and at this stage starts the transfer of the fund to local producer organizations. A recovery rate of at least 90% and a field reinvestment are expected.

a) Technical Unit Generic Functions

The TU configured in the framework of the Program will focus its services on making the Trust mechanism viable and ensuring an implementation aimed at facilitating, transferring capacities and increasing the productivity of the cocoa chain in the RACCN intervention zone.

This Unit, in its role as facilitator, will secure the fulfillment of the established criteria, and will ensure that other organizations of producers will identify and guarantee the technical and social incorporation of producers in this initiative, as well as strengthen local organizations of producers with good potential. In addition, it will promote and facilitate commercial alliances with the companies that buy sustainable cocoa in the territories, building a relationship of trust, security and responsibility.

The TU will boost the execution of the fund, by supporting producers and territorial organizations in the implementation of a face-to-face marketing and promotion strategy that capitalizes on existing relationships, both to promote products (genetic material, inputs and financing of labor), as well as services (technical assistance, training) to accelerate the launch of the operation. Additionally, the availability of resources will be managed in this Unit, to provide timely financing and to promote their efficient execution.

The dynamics of the economy, the market and the production are changing and require their permanent evaluation to adapt the conditions under which the Trust will operate. The TU, based on the analysis of the demand and the behavior of the financed producers, will also propose the modification or adaptation of the conditions of the Trust, considering the operation of other actors in the business ecosystem.

2. Options for private sector participation through PPP

a) Co-financing

Companies such as RITTER SPORT, ECOM-EXPASA, ETHIQUABLE and ZOTO, have designed financing strategies that normally work as payments in advance on the harvest to organizations of producers. These purchase advances allow them to buy cocoa bean in pulp, process it and market it.

Additionally, financing experiences that some companies have developed for the payment of labor and supplies, can potentially be strategies that could be negotiated within the framework of this implementation under a win-win philosophy.

In the North Caribbean Coast Autonomous Region, cocoa producers have access to land, but none of the cooperatives, financial or micro-financial institutions have credit programs (without subsidy) for pre-harvest, or long-term expenses for expanding the cocoa area, condemning them to a small productive scale that slows down the possibilities of modifying the income pattern, and thereby changing their condition of being considered as a high-risk agricultural pledge portfolio.

b) Co-execution with the private sector

This strategy would include the negotiation of some components of the Program, capitalizing on the main experience that commercialization companies have, considering their interests and budgetary capacity.

Some components that could be considered to be executed by the private company are: quality, technical assistance, certification and credit for the management and purchase of the crop. Buyers such as RITTER SPORT, EXPASA, ETHIQUABLE, ZOTO, could be key actors in this process, as well as large producers like CACAO ORO, KAKAU and MLR that would be strategic allies in the provision of high quality genetic material and training.

3. In-kind incentives

Within the framework of this proposal, this program could allocate 25% of the cocoa plants, 100% of triple CAL, the labor for the plant establishment, the technical assistance, and the forest trees as in-kind incentives for families that are actively involved in the implementation. The accreditation of this donation to their loan would be done until the end of the project, based on the performance results obtained.

4. Loans with agricultural pledge

Most of the time, the lack of cash does not allow families to meet with their basic needs. For this reason, this proposal supports the strategy in which the private sector finances the producers, directly or through their cooperatives.

This cash would be disbursed progressively as payment of labor, on the real progress of the work in the plots. The establishment of technological charts that precisely define the number of work days needed to do a job, and the frequent monitoring and control are critical in the implementation of this concept.

This initiative is part of the creation of opportunities, to promote sustainable forest management and to maximize growth and development of established species.

5. Emission Reduction Purchase Agreement

Through the Forest Carbon Cooperative Fund of the ENDE-REDD+ program, the Nicaraguan government committed to reduce emissions by approximately 11 million tons of carbon dioxide in Nicaragua, for which 55 million dollars will be received in five years, which could be used as an additional incentive for small producers, for their compromise for taking care of the recently established and previously planted trees.

E. Socio-economic and environmental impacts

The transformation model is expected to impact all the activities of the value chain (Table 23). It will particularly focus on gathering the producers into clusters, and provide high quality cocoa clones in an organized agroforestry system. The major impact expected is more sustainable cocoa production, with an enhanced access to the market, allowing the producers to achieve better livelihood. It is projected to positively influence the three pillar of the sustainability: economic, social, and environmental.

Table 23. Expected impacts of the transformation model towards a cocoa production in AFS model, in the different activities of the cocoa value chain.

Cocoa value chain	BAU	Bio-CLIMA	Expected impacts of the project
Inputs	Low quality genetic material (seeds).	High quality material (selected clones).	Increase of the productivity and the profitability.
			Better resistance to P&D, less chemical inputs.
	Disorganized AFS.	AFS designed and organized, selected shade trees.	Higher forest tree density, higher carbon capture.
			Preservation of the biodiversity, better pollination which lead to a higher productivity, better resistance to pest and disease.
			Conservation of the soil fertility, nitrogen fixation.
			Climate change mitigation.
Production	Pastoral and deforested lands	Cultivation of cocoa in AFS.	Fruit trees enhance food security.
	Small plots for cocoa cultivation (less than 1 ha), low density plantation frame.	2 ha per producer of cocoa plantation in AFS, organized cocoa plantation.	More efficient use of the land.
	Little shade management.	Good practices of shade regulation provided by TA.	Economy of scale, better profitability.
	Precarious technology of production.	TA will provide training of good agricultural practices.	Increase of the productivity.
	Low constancy and quality of crop management.	TA will provide training of good agricultural practices. Incentive for good production.	Increase of the productivity.
Processing	Producers dispersed and scattered, low access to processing plants.	Focus on routes and cluster to facilitate access to processing facilities.	Increase of the quality, economy of scale, better organization of the cocoa value chain.
	Little quantity is properly processed.	TA will provide training of good fermentation and drying practices. It will encourage producers to integrate pre-existing cooperatives. Use of standard of fermentation and drying protocols.	Increase of the quality, the uniformity, the reproducibility and the flavor of the cocoa.
Commercialization	Producers sell cocoa in its pulp to intermediary.	Producers sell to cooperative that process and commercialize the cocoa.	Increase of the quality, the volume, better prices.

	Little connection to market.	Creation of a cluster that integrate anchor companies and producers organizations.	Better market connection.
Services	Low to no access to financial support	Access to credit through the cooperative and the private sector	Financial sustainability
	Low to no access to technical assistance	Partner with Private company for technical assistance.	Sustainable cocoa production
	Very low number of certified farms	The TA will provide access to certification through alliance with the private sector	Sustainable cocoa production

1. Environmental impacts of the model

a) Sequestration and storage of GHG

Agroforestry cocoa systems are accredited for storing significant amounts of carbon and, therefore, have the potential to mitigate the climate change. The composition of the agroforestry system provides a broad set of morphological and functional features, which allows to play with the species to optimize the design of the model. A study in Waslala estimated carbon sequestration of cocoa plantations in agroforestry systems (Somarriba, et al., 2013). Taking into account an average of 866 plants per ha, including 545 cocoa trees, 117 musaceae, 104 timber trees, 52 fruit trees, and 47 palms, the authors calculated an average carbon capture per ha of 80-120 tons in 20 years (5.4 tCO₂eq / ha / year). Considering a pastoral landscape baseline of 2.4 tCO₂eq / ha / year, the cocoa agroforestry system will increase the capacity of carbon sequestering by 44%.

Small producers would have to organize into larger groups to accumulate a marketable amount of certified carbon. Voluntary markets seem to be the most appropriate (Somarriba, et al., 2013). Cocoa producers can choose from several voluntary standards compatible with the market (Table 10). Tandem standards, which consider climate change, social aspects of fair production and ecological sustainability (organic or low input, friendly to biodiversity, etc.) seem appropriate for small farmers (Somarriba, et al., 2013). In addition, these standards point towards the sustainable production of cocoa, in line with the strategies of the model.

b) Reduction of the environmental impacts of deforestation

One of the main problems caused by the loss of vegetation cover derives mainly from deforestation and forest degradation. The cocoa model in the agroforestry system aims to reforest with a density of 1,734 trees per ha, including 816 cocoa trees, 816 musaceae plants, 51 forest trees, and 51 fruit trees. This model will mitigate the effects of deforestation, mainly emissions from land use, and forest degradation. Planting trees will allow local producers to:

- restore hydrological cycles,
- mitigate global warming, soil loss,
- rehabilitate habitats for fauna and flora, as well as scenic and landscape beauty,
- increase the production of timber and non-timber forest products,
- increase agricultural production by increasing the amount and fertility of the soil,
- increase biodiversity,

- recreate and reactivate biological and ecological corridors of the BOSAWAS buffer zone.

c) Reduction of soil erosion

At the soil level, planting agroforestry systems, living fences, and short-cycle cultivation will prevent landslides and erosion by binding soil to sloping land with their root system, protecting the soil from the impact of rain, and transpiring large amounts of water, which counteracts very wet soil.

2. Increase of income for producers

In this initiative, the private companies can increase the access to markets of more stable prices that would enable small producers to have a projected income that, among others, encourages the planting of new areas of cocoa that would be the key to increasing their productive scale and thereby their income standard.

Currently in Nicaragua, the average cocoa producer cultivates 1 ha and produces 200-600 kg / ha. With the present production model, its 2 ha of cocoa producing 935 kg / ha with access to the Market, allows the producer to receive a gross income of USD 4,000 per two hectares per year.

That amount of money of USD 4,285, divided by 12 months, is equivalent to a monthly average of USD 357, which is nearly to double the minimum wage in the country. Under this scenario, the producer can use 30% of his income to pay off his Long-Term debt and interest and 70% to cover family expenses.

The model proposes to finance 2 hectares of cocoa per family, to favor a production volume that ensures that future income will not be as sensitive to price fluctuations as when they only cultivate 1 hectare of cocoa. The model prioritizes the controlled expansion of beneficiaries depending on the results of the first year, promoting investment in producers that show an effective interest in fulfilling the commitments stated by the project.

3. Women's entrepreneurship

The program would have the possibility of developing affirmative measures to integrate women who wish to become entrepreneurs into economic dynamics. One of the options is that the assisted reproduction of forest species is left in their hands, using reproduction techniques by buds, using less polluting materials, such as tubes, ellepot and trays in controlled environments.

4. Food security

The production generated by the fruit trees included in the agroforestry system will be a source that will contribute to increase the availability of food. However, it will be the increase of income generated either by the labor or by the sales of the production from year three, which will favor an improvement in the family's diet.

F. Sustainability analysis

1. Social sustainability

This Program would contribute in an extraordinary way to local governance and the establishment of a productive social network in the territories where it is implemented. The generation of income and the valorization of the livelihoods of small producers increase the availability of resources in families and with it, their hope for a better future for the family circle.

Non-hierarchical coordination between public and private actors (including those of the social economy) to achieve collectively defined goals in which different capacities are recognized, generate an

environment of collaboration and economic dynamism that creates employment, improves cocoa quality and expands its commercialization opportunities.

2. Economic sustainability

Some approaches in this regard would be marked by the temporality of products, which tend to assume a more commercial approach when there is better access to markets, while the production for self-consumption becomes a more important factor at greater distance or isolation.

For the different communities of the region, the production will start within the first years of the project, with a very important contribution of musaceae (banana and plantain) and citrus in the first couple of years. Both annual and perennial products are largely marketed, and costs and revenues reflect the commercial approach, with relatively high investments in labor (even contracted). It will be what will favor greater economic sustainability in the family.

3. Environmental sustainability

The environmental benefits are important given the ability of agroforestry systems to contribute to the recovery of degraded areas. Small producers have less access to fertile land and generally have limited access to land even those that are highly degraded.

The variability that exists within the tree species, in their contributions to environmental sustainability. However, agroforestry systems stand out in their whole, with incredibly varied benefits such as: oxygen production, contribution of plants to soil moisture, water availability with the usual effects on local climate improvement, biodiversity recovery, soil fertility improvement, erosion control and the contribution of plants to pest control are invaluable revenues of this model.

G. Risk analysis for the model adoption and implementation, and their mitigation measures.

1. Analysis of experiences and risk identification

Table 24. Risk analysis for the model adoption and implementation, and their mitigation measures (M: Medium; L: Low).

Risks	Measures	Risk level
Reproducing parallel models of implementation in the territory would significantly reduce the impact.	Develop a public-private partnership strategy, based on a win-win approach.	M
Maintain the practice of dispersion of areas in the territories and without connection to collection routes and services.	Focus and if possible design an alliance strategy that capitalizes on the benefits of the interested Anchor Companies (they can benefit and be classified as socially and environmentally responsible).	M
The producers sell their production to the high demand conventional local market (red cocoa, low quality), which would reduce the income that could be achieved with fairer prices.	Develop an effective communication of the benefits package that could be put at risk and the transparent management of negotiations with the trading companies.	M
The implementation combines the usual practices that are handled by small producers with the requirements established in the	Ensure the technical assistance during the establishment stage, so that the planting design per unit and hectare is applied.	M

model, which would negatively affect plant yields and therefore their productivity.		
Small producers are not interested in establishing forestry.	Establish financial incentives for payment of labor during pre-sowing and sowing activities.	M
Loss of genetic purity due to non-management of shoots, which would affect the quality and productivity of plantations.	Develop Field Days to learn the technique of control of shoots. Assign payment of labor, to develop the workforce.	L
Little inclusion of women as direct beneficiaries of the program is an imbalance that does not favor empowerment and opportunities to generate substantive changes in their living conditions.	Develop specific economic initiatives for women like fruit and forest nurseries.	M
The volatility of commodity prices, or the exit of RITTER SPORT, would collapse the local market.	Work hard to increase quality. Search for alternative markets and alliances that reduce the dependence on a single actor.	L
Non-stable income during the implementation of the first two years of the project.	Inclusion of financial incentives for payment of labor during pre-sowing and sowing activities. Opportunity to develop short cycle crops to guarantee food security in the first two years.	M

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